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THE BEAT CEPHEIDS NSV 6728, GSC 8607-0608, EY Car AND BE Pup

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The online edition of the General Catalogue of Variable Stars (GCVS, Kholopov et.al., 2003) lists sixteen Galactic double mode or beat Cepheids (GCVS type CEP(B) or DCEP(B)). In addition to these sixteen stars, DZ CMa (Berdnikov and Turner, 1998) and HD 304373 (Beltrame and Poretti, 2002), have been found only recently to be beat Cepheids. Two other stars, V371 Per (Schmidt et.al., 1995) and BE Pup (Hacke and Richert, 1989), are suspected of being double mode pulsators (Welch, 1998). Only CO Aur and HD 304373 are pulsating in the first and second radial overtones, all other stars pulsate in the fundamental (F) and first overtone (1O) modes.

From the publicly available ASAS3 survey data (Pojmanski, 2002), we found that also NSV 6728, GSC 8607-0608 and EY Car are double mode Cepheids, pulsating in F and 1O modes. In addition, we could confirm the double mode nature of BE Pup, so that the number of known Galactic beat Cepheids has now risen to 22. The source data for BE Pup, GSC 8607-0608, EY Car and NSV 6728 can be found at the ASAS3 home page. The electronic version of the IBVS contains direct links. Fundamental data about the four stars are listed in Table 1. It includes values for the invariant Fourier parameters and for the generalized phase difference $G_{1,1}$ of the cross coupling term $f_0 + f_1$ as defined by Poretti and Pardo (1997). Formal errors are given between parentheses in units of the last significant decimal.

Table 1: Characteristics of the four new double mode Cepheids

	NSV 6728	GSC 8607-0608	EY Car	BE Pup
V Range	9.75-10.35	10.70-11.40	9.90-10.45	13.0-13.9
HJD Maximum	2452082.85	2452655.94	2451891.71	2452981.78
Period F (d)	4.317(7)	4.089(3)	2.876(3)	2.870(3)
Period 1O (d)	3.037(3)	2.869(4)	2.036(2)	2.048(2)
Period ratio (1O/F)	0.7035(14)	0.7017(11)	0.7077(8)	0.7136(8)
R_{21}(F)	0.21(1)	0.18(2)	0.30(2)	0.39(12)
R_{21}(1O)	0.11(2)	0.07(2)	0.16(7)	0.46(25)
Φ_{21}(F)	4.40(3)	4.20(7)	4.01(5)	3.96(34)
Φ_{21}(1O)	4.97(7)	5.12(14)	4.60(44)	3.44(41)
Amplitude ratio (1O/F)	0.61(1)	0.72(2)	0.22(2)	0.49(13)
$G_{1,1}$	4.31(5)	4.35(6)	3.90(6)	3.38(35)

NSV 6728 (= BV 447 = GSC 8691-1294 = CPD−57 6710) was suspected of variability by Strohmeier et al. (1964). Phase plots for the fundamental period and for the first overtone, after prewhitening for the fundamental period and three harmonics, are presented in Figs. 1 and 2.

GSC 8607-0608 (= CPD−56 2913 = TDS 7069) is noted as either a fundamental or first overtone Cepheid by Pojmanski (2004). It is a double star (TDSC 28377, Fabricius et.al., 2002) with a separation of $0\farcs9$ and a primary star with $V_T = 11.44$ and $B_T - V_T = 1.26$, and a secondary with $V_T = 11.86$ and $B_T - V_T = 1.17$. Because ASAS3 cannot resolve this pair, it is impossible to determine which of the components is variable. Because of the period ratio of 0.7017 ± 0.0011, it is however highly unlikely that both components are normal single-mode Cepheids, rather than one being a beat Cepheid. The proper motions of the components given by TDSC are identical, so that it could be a physical pair. Y Car, a spectroscopic binary (Böhm-Vitense et al., 1997), has been the only known beat Cepheid in a multiple system (Szabados, 2003). The phase plots from ASAS3 data for GSC 8607-0608 are given in Figs. 3 and 4.

EY Car (= GSC 8957-1924 = HIP 52380) had been suspected of being a beat Cepheid before, based on (sparse) data from Mitchell et al. (1964). It was therefore observed by Pike and Andrews (1979), and later also by Mantegazza and Poretti (1992), but they failed to detect the first overtone pulsation. Since these authors observed the star for only three and two weeks respectively, and the first overtone period of EY Car turns out to be close to two days, the phase coverage was poor. Combined with the small amplitude of the first overtone variation, this explains why these authors did not find it. The star is also near the limiting magnitude of Hipparcos (ESA, 1997), so that it is not surprising this instrument did not reveal a secondary frequency. The phase plots from ASAS3 data are given in Figs. 5 and 6.

BE Pup is not catalogued in the GSC version 1, its GSC 2.2 position is $\alpha_{2000} = 07^{\rm h}33^{\rm m}35\fs486$, $\delta_{2000} = -25°50'37\farcs18$. It is near the faint limit for accurate observations of ASAS3. The errors in Table 1 and the scatter in the phase plots in Figs. 7 and 8 are therefore larger than for the other three stars. BE Pup was classified as a possible population II object (GCVS type CWB:) by Fernie and Hube (1968), based on a deduced distance of 400 *pc* from the Galactic plane. However, no spectroscopic observations are available to confirm this. Fernie and Hube (arbitrarily) chose 400 pc as the lower limit for population II objects. BD Pup, close to BE Pup, but at a distance of 390 pc from the Galactic plane, was classified as a population I Cepheid.

The fundamental periods of BE Pup and EY Car are almost the same, but their period ratios are significantly different. This indicates that there is no simple relation between the fundamental period and the period ratio, but an other parameter such as metallicity is involved as well (Morgan and Welch, 1997). A plot of the period ratio against period for all known Galactic double mode (1O/F) Cepheids is given in Fig. 9. For previously known beat Cepheids, data from Welch (1998) have been used (points). The stars discussed in this paper are denoted by crosses. Fig. 10 plots the values of the generalized phase difference $G_{1,1}$ for the cross coupling term $f_0 + f_1$. Values are taken from Poretti and Pardo (1997), supplemented with values derived from the ASAS3 data for some additional stars. The lowest value (with the largest error bar) is for BE Pup.

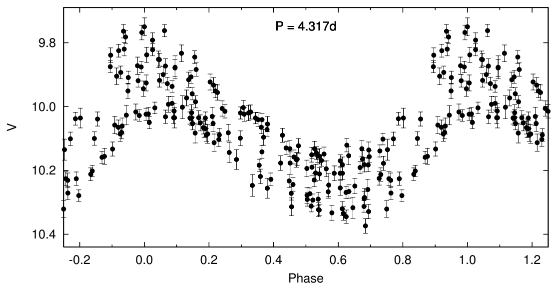

Figure 1. ASAS3 phased light curve for the fundamental period of NSV 6728.

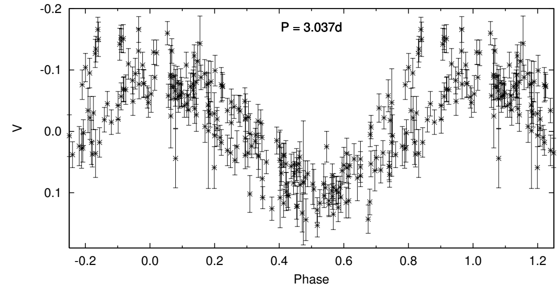

Figure 2. ASAS3 phased light curve for the first overtone period of NSV 6728 after prewhitening with the fundamental period and harmonics.

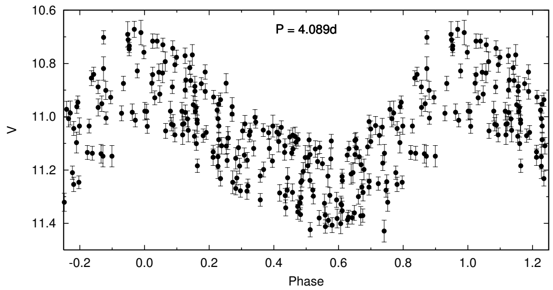

Figure 3. ASAS3 phased light curve for the fundamental period of GSC 8607-0608.

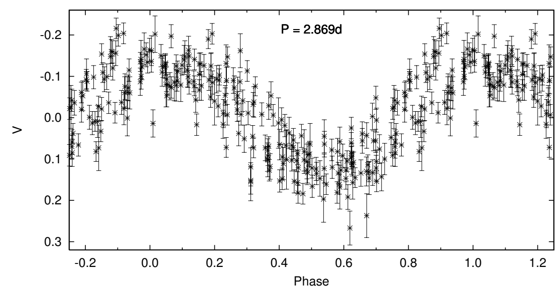

Figure 4. ASAS3 phased light curve for the first overtone period of GSC 8607-0608 after prewhitening with the fundamental period.

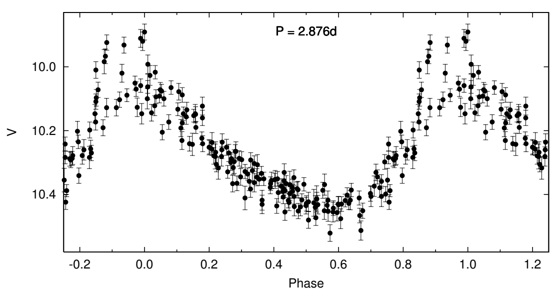

Figure 5. ASAS3 phased light curve for the fundamental period of EY Car.

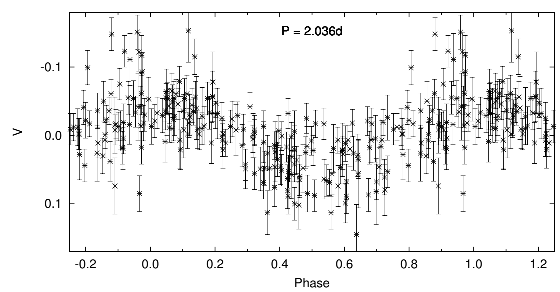

Figure 6. ASAS3 phased light curve for the first overtone period of EY Car after prewhitening with the fundamental period and harmonics.

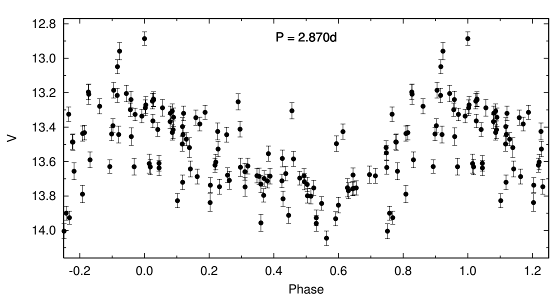

Figure 7. ASAS3 phased light curve for the fundamental period of BE Pup.

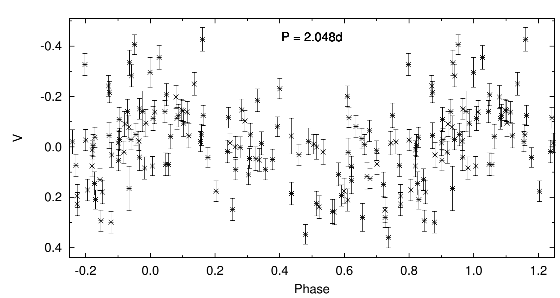

Figure 8. ASAS3 phased light curve for the first overtone period of BE Pup after prewhitening with the fundamental period and harmonics.

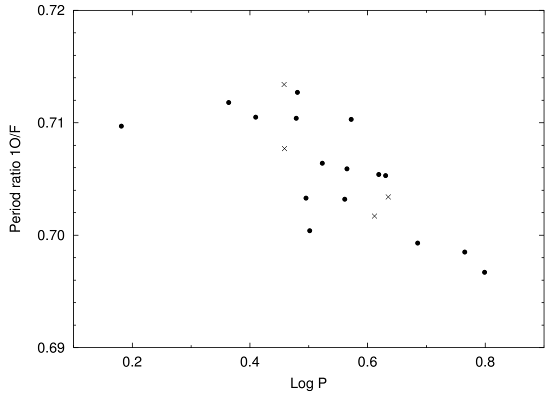

Figure 9. Plot of the 1O/F period ratio versus fundamental period for Galactic beat Cepheids.

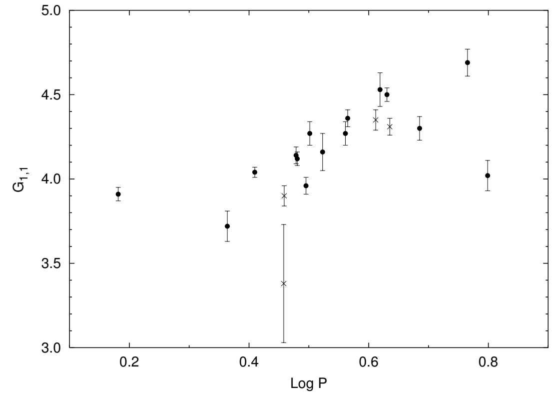

Figure 10. Plot of the phase difference $G_{1,1}$ versus fundamental period for 1O/F pulsators.

Acknowledgements: This research has utilised the ASAS3 public photometry catalogue and the SIMBAD and VizieR databases operated at the *Centre de Données Astronomiques (Strasbourg)* in France. The authors are grateful to John Greaves for helpful discussions and to Paul Van Cauteren for providing access to the Mitchell et al. paper.

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TIMES OF MINIMA FOR NEGLECTED ECLIPSING BINARIES IN 2003

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Observatory and telescope:
25cm catadioptric telescope at Rolling Hills Observatory (RHO)

Detector:	CB245 camera, Peltier cooling, TI TC245 chip, $11' \times 8'$ FOV, 252×242 pixels. SBIG ST-9XE, Peltier cooling, Kodak KAF-0261 chip, $18.5' \times 18.5'$ FOV, 512×512 pixels.

Method of data reduction:
Reduction of the CCD frames was done with sextractor and custom-written applications.

Method of minimum determination:
The times of minima were computed using the Kwee and van Woerden method as implemented in AVE [1].

Observed star(s):

Star name	GCVS type	Coordinates (J2000) RA	Dec	Comp. star	Ephemeris E 2400000+	P [day]	Source
CN And	EW/KW	00 20 30	+40 13 34	2786-406	41577.2969	0.4627959	1
CW Aqr	EB/KE	22 19 22	−16 53 33	6378-1382	26192.548	0.542909	1
BF Aur	EB	05 05 03	+41 17 19	2903-882	40628.3643	1.5832208	1
FP Aur	EA	05 43 39	+30 53 32	2405-1617	25984.3629	0.947236	1
XY Boo	EW/KW	13 49 12	+20 11 25	1466-38	39953.9621	0.37054663	1
WY Cnc	EA/SD/RS	09 01 55	+26 41 23	1953-287	26352.3895	0.82937122	1
TZ CMa	EA	06 41 47	−19 40 25	5957-576	27124.8709	1.911446	1
CX CMa	EB/KE	07 22 01	−25 52 36	6541-2195	28095.6009	0.954608	1
DE CMa	EA/KE	07 25 10	−27 19 18	6546-3662	28083.933	0.695964	1
UZ CMi	EW/DW	07 50 52	+03 39 04	184-1703	25243.6899	0.76195	1
AL Cas	EW	02 13 45	+70 08 43	4315-356	44490.3659	0.50055583	1
AX Cas	EB	01 23 50	+61 34 28	4030-2086	28626.4419	0.600376	1
IV Cas	EA/SD	23 49 31	+53 08 05	4001-1012	40854.597	0.9985245	1
MM Cas	EA/SD	00 54 35	+54 26 36	3672-441	35401.483	1.15847	1
V0445 Cas	EB	00 31 40	+53 12 60	3654-1723	41921.3782	0.67352	1
SU Cep	EB/KE	21 46 41	+57 17 37	3976-1273	26325.4649	0.9014011	1
BE Cep	EW/KW	22 41 21	+58 36 31	3996-1253	28751.3089	0.42439595	1
IO Cep	EA/SD	21 10 31	+57 43 09	3961-333	30729.2799	1.2358073	1
V0496 Cyg	EA/KE:	20 19 40	+35 47 08	2684-974	28805.6069	1.474915	1

[1] AVE is written by Rafeal Barbera (rbarb@astro.gea.cesca.es) and the software can be obtained from http://www.astrogea.org/soft/ave/introave.htm

Observed star(s):							
Star name	GCVS	Coordinates (J2000)		Comp. star	Ephemeris		Source
	type	RA	Dec		E 2400000+	P [day]	
LS Del	EW/KW	20 57 10	+19 38 52	1656-946	42687.418	0.3638	1
BV Dra	EW/KW	15 11 51	+61 51 19	4180-60	44474.327	0.3500671	1
BW Dra	EW/KW	15 11 51	+61 51 35	4180-60	42572.538	0.2921671	1
RU Eri	EB/KE	03 54 44	−14 55 59	5882-462	42359.3456	0.63219951	1
AA Eri	E	04 13 42	−11 33 30	5315-1087	24801.7999	0.50085	1
BW Eri	EB	04 06 37	−27 40 02	6462-112	43448.6839	0.6384773	1
BZ Eri	EA	04 12 13	−06 01 13	4732-1543	25558.4449	0.6641701	1
AV Gem	EA/SD	06 42 02	+13 24 57	758-2037	27832.6099	1.2216548	1
BD Gem	EA/SD:	06 34 43	+15 35 01	1329-893	27414.532	1.616727	1
FG Gem	EA	06 47 50	+16 51 55	1330-834	27102.3999	0.819129	1
CC Her	EA/SD	16 17 39	+08 55 59	946-1287	39668.342	1.7340058	1
MT Her	EB/SD:	18 21 51	+14 30 28	1022-1381	41117.4169	0.48771779	1
V0878 Her	EB	17 24 25	+49 38 34	3516-165	52118.4404	0.52947826	2
IZ Lac	EB/KE	22 13 05	+51 49 25	3618-2154	32768.515	0.798878	1
UZ Leo	EW/KE	10 40 33	+13 34 02	845-718	39800.373	0.6180428	1
AM Leo	EW/KW	11 02 11	+09 53 45	847-1357	42493.389	0.3657974	1
RZ Lyn	EB/KE	09 36 10	+41 17 01	2995-1196	25643.31	1.146918	1
UU Lyn	EB/DM	09 15 30	+42 42 16	2990-237	44674.048	0.46846016	1
DD Mon	EB/KE	06 45 57	+00 16 51	4800-1104	30321.453	0.56801193	1
GU Mon	EW	06 44 47	+00 13 20	147-1072	30345.347	0.89668149	1
IZ Mon	EB	07 00 52	+08 48 48	748-849	27344.6209	0.7798089	1
V0496 Mon	EB	06 37 45	+03 18 03	151-121	32915.4155	0.6607649	1
V0508 Oph	EW/KW	17 58 49	+13 30 39	1019-1979	45082.543	0.344792129	1
V0343 Ori	EW/DW	06 05 00	+12 33 11	725-895	33599.379	0.809126	1
V0392 Ori	EA/KE:	06 11 25	+18 33 06	1318-771	25506.62	0.659284	1
V0640 Ori	EA/SD	05 55 00	−09 22 09	5348-1219	28897.341	2.02074	1
FF Ori	EA/SD:	05 35 11	+02 57 01	118-1866	32216.367	1.810524	1
BY Peg	EW/KW	21 38 55	+28 06 45	2201-161	45565.518	0.3419372	1
KR Per	EB/KE	04 37 09	+44 12 51	2892-695	35718.4882	0.99607883	1
DS Pup	EW/KW	07 32 48	−24 58 44	6543-290	28084.628	0.3886763	1
EN Pup	EW	07 42 45	−26 36 24	6548-3387	26305.551	0.6721498	1
RZ Pyx	EB/KE	08 52 04	−27 28 59	6580-156	38431.4739	0.656273	1
AU Ser	EW/KW:	15 56 49	+22 15 37	1502-1472	44722.4744	0.38650086	1
AL Tau	EA	05 33 53	+26 01 31	1852-698	35130.4018	0.930658	1
CR Tau	EA	05 51 29	+24 03 45	1862-2270	26004.35	0.681346	1
BH UMa	EW/KE	10 45 56	+52 14 56	3449-746	45093.348	0.6986834	1
AG Vir	EW/KE	12 01 04	+13 00 31	871-330	45432.4145	0.64265075	1
CX Vir	EW	14 09 26	−15 35 07	6138-644	26092.45	0.746077	1
BK Vul	EW/KW	21 25 24	+27 51 27	2195-2142	24767.7	0.45347	1

Source(s) of the ephemeris:
1.: Kholopov et al., 1985; 2.: Agerer et al., 2002

Times of minima:						
Star name	Time of min.	Error	Type	Filter	$O-C$	Rem.
	HJD 2400000+				[day]	
CN And	52901.8225	3	I	V	0.0590	
	52935.6071	3	I	V	0.0600	
CW Aqr	52971.5268	3	I	–	−0.0076	
BF Aur	52657.691	2	I	V	0.014	
FP Aur	52957.7890	6	I	–	−0.0663	
XY Boo	52684.8363	3	I	V	0.0036	
WY Cnc	52744.6172	1	I	V	−0.0233	
TZ CMa	52980.8107	1	I	–	−0.1903	
CX CMa	52654.7236	3	I	V	−0.0774	
DE CMa	52648.6607	5	I	–	−0.0176	
UZ CMi	52663.6934	6	II	V	0.0897	
AL Cas	52966.775	1	I	–	−0.003	
AX Cas	52992.6268	2	I	V	−0.0752	

Times of minima:						
Star name	Time of min. HJD 2400000+	Error	Type	Filter	$O-C$ [day]	Rem.
IV Cas	52935.703	1	I	V	−0.042	
	52964.6589	3	I	–	−0.0432	
MM Cas	52646.5415	2	I	–	0.0741	
V0445 Cas	52648.5846	2	I	–	0.0534	
SU Cep	52816.7475	4	I	V	0.0056	
BE Cep	52976.5927	3	I	–	−0.0859	
IO Cep	52894.7165	5	I	V	−0.0032	
V0496 Cyg	52750.860	1	I	V	0.008	
LS Del	52952.6005	6	I	–	0.1587	
BV Dra	52729.7820	2	II	V	0.1726	
BW Dra	52729.6943	2	I	V	−0.0329	
RU Eri	52991.6526	2	I	–	−0.0244	
AA Eri	52980.691	2	I	–	0.0685	
BW Eri	52664.5848	4	I	V	0.1195	
BZ Eri	52982.6971	3	I	–	0.0045	
CC Her	52723.8039	2	I	V	0.1322	
MT Her	52788.806	2	II	V	0.058	
V0878 Her	52743.7486	3	I	V	−0.0056	
AV Gem	52645.613	3	I	–	−0.027	
BD Gem	52966.8781	4	I	–	−0.0241	
FG Gem	52959.8128	3	I	–	−0.0323	
	52991.7589	1	I	–	−0.0323	
IZ Lac	52967.642	2	I	–	0.296	
UZ Leo	52785.5981	4	I	V	0.1459	
AM Leo	52682.8617	4	II	V	−0.0058	
RZ Lyn	52773.5830	5	I	V	−0.0723	
UU Lyn	52644.8921	3	I	–	−0.0056	
DD Mon	52695.5718	3	I	V	0.1289	
	52964.8129	2	I	–	0.1323	
GU Mon	52647.6482	4	I	–	0.0392	
IZ Mon	52992.820	2	I	V	−0.255	
V0496 Mon	52647.8098	3	I	–	0.0462	
V0508 Oph	52935.5247	4	I	V	−0.0038	
FF Ori	52682.550	1	I	V	0.020	
V0343 Ori	52683.5875	4	I	V	0.1627	
V0392 Ori	52654.6209	4	I	V	0.0043	
V0640 Ori	53000.6207	1	I	V	−0.1070	
BY Peg	52973.5522	1	I	–	−0.0352	
KR Per	52712.5783	6	I	V	−0.0108	
	52957.6093	3	I	–	−0.0152	
	52966.5746	4	I	–	−0.0146	
DS Pup	52991.8610	2	I	–	0.0783	
	53000.8011	2	I	V	0.0789	
EN Pup	52956.9100	4	I	–	−0.0527	
RZ Pyx	52660.8009	8	I	V	0.0157	
AU Ser	52673.8759	3	I	V	−0.0808	
AL Tau	52656.6115	3	I	–	0.0582	
CR Tau	53000.5484	3	I	V	−0.0928	
BH UMa	52669.875	1	I	V	0.004	
AG Vir	52747.700	1	I	V	−0.025	
CX Vir	52681.8951	8	I	V	0.0069	
BK Vul	52959.5348	6	I	–	0.0584	

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Agerer, Franz, et al., 2002, *IBVS* No. 5296

Kholopov, P.N., et al., 1985, *General Catalog of Variable Stars*, 4th Eds.

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SOME NOTES ON MAYALL'S VARIABLES

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Margaret Mayall discovered 15 new variables (14 of Me type and 1 of N type) by examination of objective prism plates taken with the 10-inch Metcalf telescope in South Africa (Mayall, 1951). They were given the designations HV 11093 through HV 11108 (except HV 11106). A comparison of information on these objects in SIMBAD and GCVS revealed a number of deficiencies in these databases viz., incomplete cross-identifications (and, hence, incomplete data listings), dissimilar co-ordinates, only approximate co-ordinates for some sources, etc. Accordingly, this effort was undertaken to try and remove at least some deficiencies.

Searching for infrared counterparts is a natural step towards this goal and the 2MASS database is an obvious choice for doing this in case of red variables. These sources were extracted from the 2MASS database using the VizieR utility (Ochsenbein, Bauer & Marcout 2000). In cases where the SIMBAD and GCVS co-ordinates matched or were close enough, the corresponding 2MASS source was easily found. In other cases, a larger search radius was required. The co-ordinates listed in Table 2 are those from 2MASS. IRAS associations were determined by a SIMBAD query around the HV position and checking whether the HV positions fell within the IRAS position error ellipse. In this manner, we have got new *IRAS* identifications for HV 11096, 11098 and 11105.

The case of HV 11094 is very interesting. According to the GCVS, it is a 17th magnitude Mira variable identified with NSV 917 and the co-ordinates listed therein match those of IRAS 02443-3626. However, totally different values are given in SIMBAD, which probably identifies the 'red star' of Deemers & Lang (1986) with HV 11094. However, as noted by the above authors, it is extremely unlikely that Mayall's survey would have picked up such a faint star. Judging from the magnitudes of other stars listed by Mayall, it is likely that HV 11094 has a magnitude between 10 and 12. Indeed, a TYCHO star of magnitude 11 lies close to the GCVS position, and its 2MASS colours correspond to a G0III star. Therefore, we believe that this is the true identity of HV 11094. The near- and far-infrared colours of IRAS 02443-3626 indicate that it also is a late-type star. This is probably the faint Mira variable NSV 917. Co-ordinates and JHK_s magnitudes of all red stars in the field of HV 11094 are listed in Table 1.

Table 1. Red stars in the field of HV 11094.

Source	RA (2000)	Dec	J	H	K_s	Comments
CD -36^o1043	02 46 05.31	−36 14 55.15	9.450	9.237	9.167	BV 1486 = NSV 919
IRAS 02443-3626	02 46 21.09	−36 13 35.58	6.331	5.511	5.003	NSV 917 ?
HV 11094	02 46 22.14	−36 13 24.92	9.937	9.633	9.518	Tycho star
Red star	02 45 0.6	−36 16 10.97	15.967	15.256	14.987	

Table 2 gives the 2MASS positions, cross-identifications and remarks (as in SIMBAD) of Mayall's variables. Table 3 gives the B and V magnitudes from SIMBAD, JHK_s magnitudes from 2MASS and the far-infrared fluxes measured by *IRAS*, thus consolidating in one place all known photometric information on these variables.

Table 2. Positions and cross-identifications of Mayall's variables.

HV	RA (2000)	Dec	IRAS	Other	Remarks
11093	02 30 10.47	−65 06 12.5	02290-6519	SX Hor	M5e ; SR, pulsating
11094	02 46 22.14	−36 13 24.92			
11095	04 02 57.29	−79 50 42.9	04058-7958	WW Men	M5e ; SR, pulsating
11096	04 28 50.33	−54 30 08.0	04277-5436	ST Dor	Son 4838 ; M0e, variable
11097	06 10 51.79	−69 00 57.6	06112-6900	SV Dor	M1e; Mira variable
11098	06 17 23.66	−61 54 07.79	06169-6152	RZ Pic	Son 4864 ; M3e, variable
11099	07 04 04.67	−16 06 22.44	07018-1601	NSV 3361	N type Carbon star
11100	07 34 28.49	−59 56 43.99	07336-5949	NSV 3655	M2e, variable ; S star
11101	09 44 54.39	−67 56 49.27	09438-6742	NW Car	Me, SR, pulsating
11102	14 30 42.417	−63 05 29.54		TYC 9010-128-1	Me, variable
11103	14 53 06.92	−33 41 45.21	14500-3329	V799 Cen	Me, variable
11104	15 01 39.42	−39 45 35.78	14584-3933	V643 Cen	M3e, Mira variable
11105	18 03 28.85	−41 53 42.00	17599-4154	V473 CrA	CSV 7749 ; Me,Mira variable
11107	19 31 05.64	−50 23 46.46		HL Tel	Son 7680 ; M0e, SR pulsating
11108	20 33 10.51	−23 40 11.28	20302-2350	NSV 13131	M5e, variable

Table 3. Optical-NIR magnitudes and *IRAS* fluxes (Jy) of Mayall's variables. The last column gives the *IRAS* flux quality in the four bands ranging from 3 (good) to 1 (bad).

HV	B	V	J	H	K_s	F12	F25	F60	F100	Fqual
11093	12		4.574±0.210	3.542±0.198	3.190±0.260	4.95	1.91	0.40	1.00	3311
11094	11.8	11.1	9.937±0.021	9.633±0.026	9.518±0.021					
11095		9.69	2.960±0.248	1.989±0.214	1.573±0.254	13.9	4.81	1.27	1.19	3331
11096	12		6.485±0.023	5.685±0.034	5.323±0.023	0.734	0.226	0.40	1.00	3311
11097	11.7		6.146±0.016	5.288±0.024	4.814±0.023	1.86	0.834	0.40	1.00	3311
11098	11.5		5.335±0.019	4.599±0.034	4.032±0.024	4.71	2.69	0.359	1.00	3331
11099	13.5	10.7	6.075±0.026	4.901±0.023	4.318±0.029	2.09	0.528	0.40	1.82	3311
11100			6.164±0.019	5.221±0.029	4.584±0.017	3.52	1.50	0.40	3.28	3311
11101	13		6.500±0.027	5.569±0.042	4.933±0.024	5.09	2.13	0.393	1.00	3321
11102	11.8	10.7	8.181±0.027	7.598±0.042	7.363±0.021					
11103			5.829±0.018	4.989±0.033	4.526±0.016	2.91	1.52	0.40	1.00	3311
11104	12		6.444±0.023	5.679±0.029	5.180±0.020	1.38	0.772	0.40	1.08	3311
11105	12.2		7.267±0.021	6.453±0.029	5.971±0.020	0.693	0.336	0.40	10.4	3111
11107	13		8.198±0.019	7.443±0.026	7.040±0.018					
11108			4.601±0.274	3.551±0.258	3.198±0.296	6.03	2.31	0.65	1.00	3321

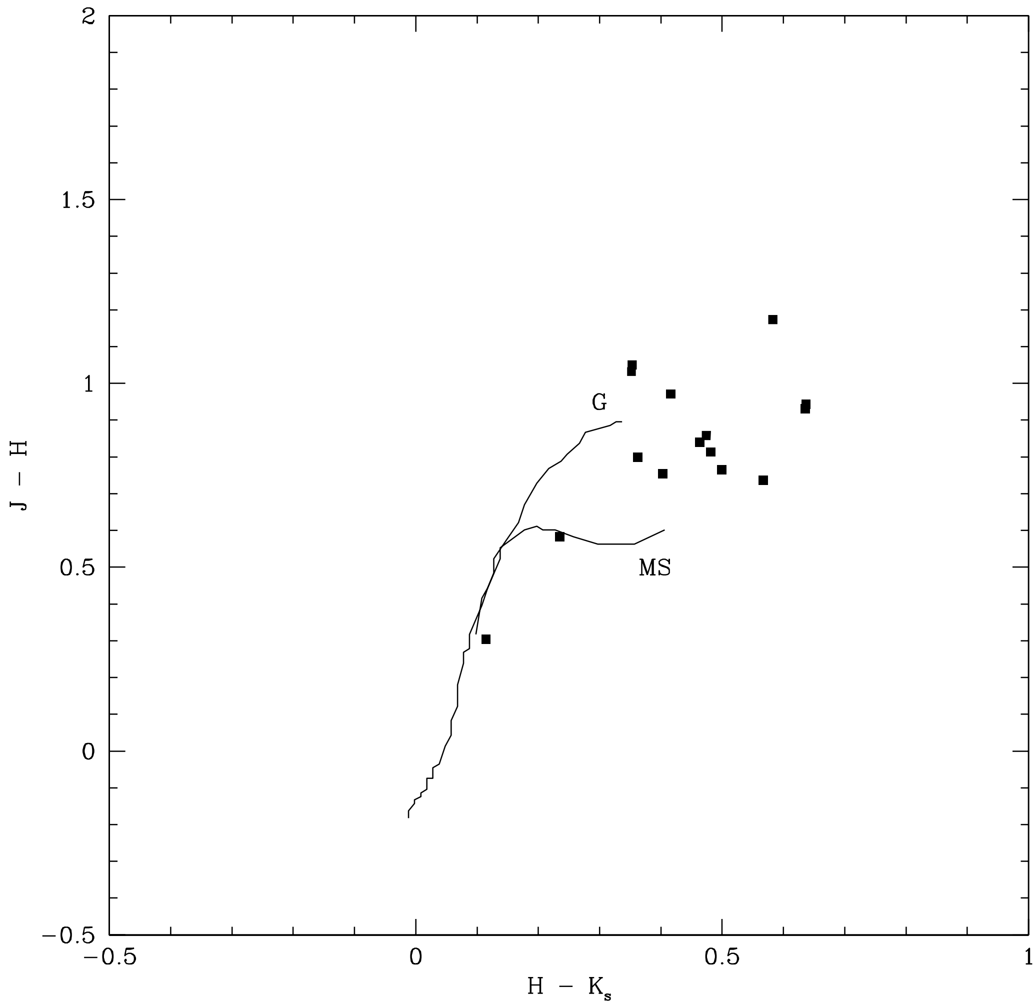

Figure 1. Near-Infrared two-colour diagram for Mayall's variables. Curves for the main sequence (MS) and giant (G) stars are also shown. It can be seen that the objects lie in the region occupied by late-type stars.

Figure 1 shows the near- infrared (2MASS) two-colour diagram for Mayall's variables. The colours of main sequence (MS) and giant (G) stars are from Cox (2000) and have been converted from Bessel & Brett (1988) to 2MASS system using the transformations given in Carpenter (2001). All objects in the sample except HV 11102 (whose $(J-H)$ colour seems to be bluish) have colours corresponding to late-type stars.

The IRAS two-colour diagram for Mayall's variables (and IRAS 02443-3626) is presented in Figure 2. Also shown are the blackbody curve (solid line) and the Mira-OH/IR star evolutionary curve (dotted) of van der Veen & Habing (1988). The regions populated by these objects are characteristic of variable stars with O-rich (II) or C-rich (VII) circumstellar shells or O-rich (VIb) and C-rich (VIa) stars having circumstellar dust.

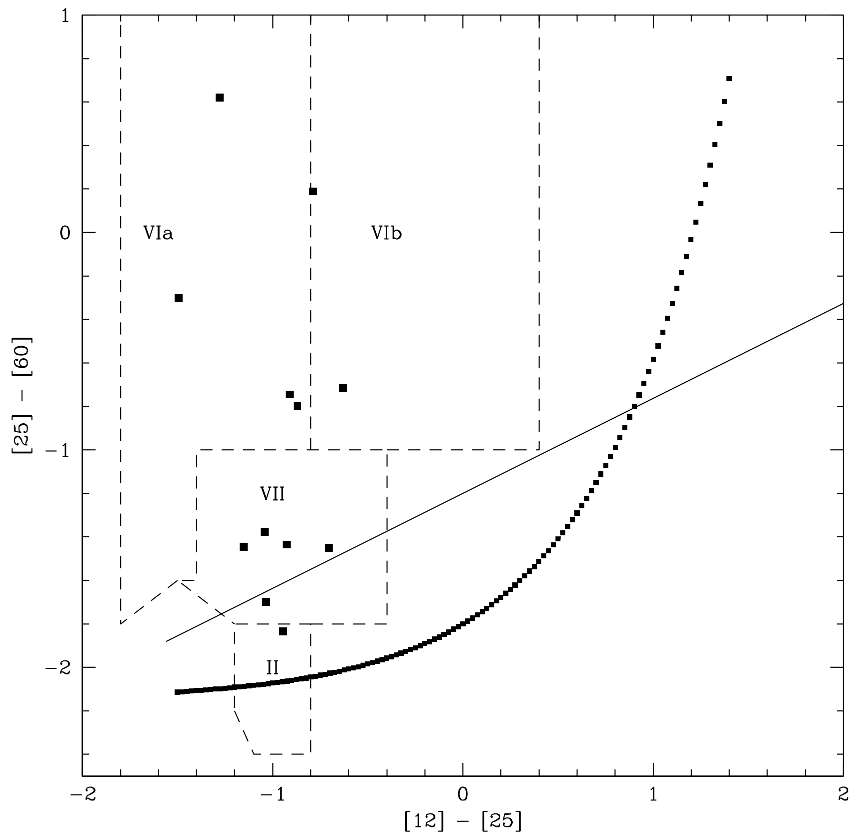

Figure 2. *IRAS* two-colour diagram for Mayall's variables (and IRAS 02443-3626). The dotted line is the Mira-OH/IR star evolutionary track of van der Veen & Habing (1988) and the solid line is that of a blackbody, starting with 10000 K at the bottom left and moving towards cooler temperatures. Again, it can be seen that Mayall's variables occupy the region populated by cool, late-type stars.

Acknowledgements :

This research has made use of the SIMBAD database (operated at CDS, Strasbourg, France) and the GCVS online database. This publication makes use of data products from the Two Micron All Sky Survey, which is a joint project of the University of Massachusetts and the Infrared Processing and Analysis Center/California Institute of Technology, funded by the National Aeronautics and Space Administration and the National Science Foundation.

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ERRATUM FOR IBVS 5503

HV 11094 is specified by Mayall to lie 'south preceding CoD-36 1043'; in addition there is a finder chart that matches this description. This makes the identification with the red star there certain, despite its evident faintness in DSS images. Thus

```
IRAS 02443-3626 = NSV 917 at: 2 46 21.09  -36 13 35.6 (J2000, 2MASS).
```

In the same field, the star given by Kamath as CD-36 1043 is actually CD-36 1041 = CPD-36 282, which is correctly catalogued in SIMBAD. The true

```
CD-36 1043 = TYC 7017-880-1 = NSV 919,
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about 20" northeast of IRAS 02443-3626, also correct in SIMBAD. The faint red star to the southwest (2 45 00.6 -36 16 11) seems to be unrelated to any of these; it is probably a distant M dwarf.

Kamath has also misidentified HV 11102, which is the relatively bright star and IRAS source IRAS 14265-6254. Again, Mayall provides a chart which makes the ID unambiguous:

```
SV* HV 11102 = IRAS 14265-6254 = GSC 9010-4846 = NSV 6681:
          at: 14 30 28.06  -63 07 45.5 (J2000, 2MASS)
```

Finally, there appears to be a -20" Dec typo for the coordinates of HV 11105. This should be given as: 18 03 28.86 -41 54 03.2 (J2000, UCAC2). There is no star at Kamath's position.

Brian Skiff

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MASS RATIO DETERMINATION OF BINARY SYSTEMS BD+14°5016, GSC 2757-769 AND GSC 3472-641[†]

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We present radial velocity studies performed for three contact binary stars recently discovered by the Semi-Automatic Variability Search[1] sky survey described detailed in Niedzielski et al. (2003). The gathered spectroscopic observations allowed us to determine radial velocity amplitudes and hence mass ratio of component stars. The observations were collected at the David Dunlap Observatory (DDO), University of Toronto, with the 1.9 m telescope and the Cassegrain spectrograph giving a dispersion of 10.8 Å mm^{-1}, corresponding to about 0.16 Å $pixel^{-1}$ or about 9 km s^{-1} $pixel^{-1}$. The spectra were centered at 5184 Å with a spectrum coverage of 310 Å. The exposure time of 20 min was used for all spectra. For reduction standard IRAF[2] procedures were employed. The velocity determinations were done with broadening function algorithm (Rucinski 1999) against a sharp-line standard star used as a template.

BD+14°5016 was discovered as a variable of W UMa type by Maciejewski et al. (2002). It is a $9\overset{m}{.}5$ magnitude star of F2 spectral type, with an amplitude of slightly smaller than 0.5 mag and with a period of 15 hours. A preliminary spectroscopic and photometric solution of this eclipsing binary was presented in Maciejewski et al. (2003a). The obtained model based on mass ratio determined from only three spectra indicates that BD+14°5016 is an A-type W UMa system in a large degree of overcontact of about 54 percent. The O'Connell effect suggests that there is a hot spot located on the surface of the more massive component.

GSC 2757-769 was announced as an eclipsing binary by Maciejewski et al. (2003b). It reaches $10\overset{m}{.}5$ and varies in brightness with an amplitude of $0\overset{m}{.}24$ and with a period of 10 hours.

Variability of GSC 3472-641 was shown in Maciejewski et al. (2003c). It is a $11\overset{m}{.}0$ magnitude W UMa system with a period of almost 8 hours and an amplitude of $0\overset{m}{.}5$.

The radial velocity measurements for all stars of interest are listed in Table 1. For every spectrum the Heliocentric Julian Date of the exposure, phase and radial velocity determinations with the deviations from the circular solution as errors are given. The

[†]Based on data obtained at the David Dunlap Observatory, University of Toronto.

[1]For further information on SAVS see http://www.astri.uni.torun.pl/~gm/SAVS/.

[2]IRAF is distributed by the National Optical Astronomy Observatories, which are operated by the Association of Universities for Research in Astronomy, Inc., under cooperative agreement with the National Science Foundation.

phase was calculated according to photometric ephemeris given in Maciejewski et al. (2002), Maciejewski et al. (2003b) and Maciejewski and Karska (2004) for BD+14°5016, GSC 2757-769 and GSC 3472-641, respectively. Radial velocities were transformed to the solar system barycenter. As a templates the stars HD 16895, HD 222368 and HD 19373 were used for BD+14°5016, GSC 2757-769 and GSC 3472-641, respectively.

Table 1. Radial velocities measurements in km s^{-1}

HJD-2450000	Phase	V_1	ΔV_1	V_2	ΔV_2
BD+14°5016.....					
2865.650087	0.7839	86.5	10.9	−190.3	16.1
2865.777699	0.9843	36.8	9.2	...	...
2871.884731	0.5731	26.5	19.8	...	...
2871.898922	0.5954	44.2	8.7	...	...
2872.834641	0.0646	−11.5	12.0	...	...
2874.676122	0.9560	57.2	20.1	−55.2	13.5
2874.692396	0.9815	40.8	12.3	...	...
2874.709168	0.0079	16.3	3.0	...	...
2874.828479	0.1952	−19.8	9.4	252.1	9.7
2874.844533	0.2204	−17.0	14.5	275.9	23.9
2874.861039	0.2463	−32.7	0.2	268.1	12.1
2875.762517	0.6618	53.4	15.2	−164.3	12.3
2879.723759	0.8814	64.0	4.8	−122.8	13.5
GSC 2757-769.....					
2880.659330	0.1990	43.9	2.8	−246.8	25.4
2880.675013	0.2364	50.9	1.6	−224.6	7.5
2880.690465	0.2733	50.4	1.5	−263.8	33.2
2880.706311	0.3111	42.8	2.7	−234.0	17.6
2880.722237	0.3491	34.0	5.3	...	...
2880.738430	0.3877	33.0	2.5	−90.8	61.7
2880.754889	0.4269	24.6	5.2	−74.2	31.3
2880.770607	0.4644	−2.9	10.4	...	...
2882.590643	0.8062	−63.3	8.2	257.6	47.6
2882.606847	0.8448	−52.4	3.3	145.3	39.3
2882.622380	0.8819	−43.1	2.2	...	...
2882.638005	0.9192	−32.2	1.5	63.2	43.3
2882.653735	0.9567	−1.3	17.6	...	...
2882.669766	0.9949	15.7	21.9	...	...
2882.688586	0.0398	12.9	4.0	...	...
GSC 3472-641.....					
2872.613955	0.2396	−184.1	17.3	129.5	5.3
2872.623503	0.2696	−185.3	15.0	131.0	3.0
2872.637554	0.3137	−199.2	13.5	133.8	9.0
2877.544484	0.7121	165.1	39.9	−110.1	12.3
2877.560722	0.7630	225.1	14.8	−117.4	8.2
2877.577099	0.8144	224.9	30.6	−124.1	8.5
2877.593777	0.8667	172.0	14.2	−96.6	4.1
2878.554534	0.8817	159.4	15.3	−99.3	15.4
2878.570830	0.9328	53.5	35.5	...	...
2888.545421	0.2340	−210.8	9.9	133.6	0.8

The radial velocity orbits were solved by least squares fitting of a sinusoid for each component from the form $V(\phi) = \gamma + K_i \sin\phi$, with ϕ being the phase, γ – the velocity of system's barycenter and K_i – the velocity amplitude. The results are shown in Figures 1, 2 and 3. The sine curves and the straight line denote circular-orbit fits and the average radial velocity γ, respectively. The derived orbital elements: the velocity amplitudes K_1 and K_2, average radial velocity γ, mass ratio q, orbit dimensions a, a_1, a_2 and component masses m_1, m_2 are presented in Table 2.

Our results obtained for BD+14°5016 are consistent with those presented in Maciejewski et al. (2003a). The mass ratio occurred to be slightly smaller, however.

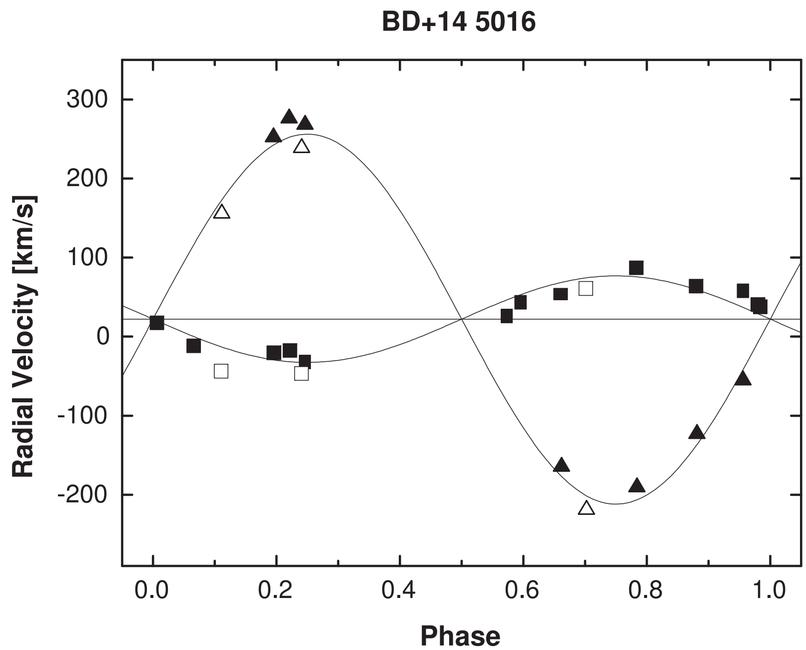

Figure 1. Radial velocities of BD+14°5016 plotted versus orbital phase. Measurements taken from Maciejewski et al. (2003a) are marked with open symbols.

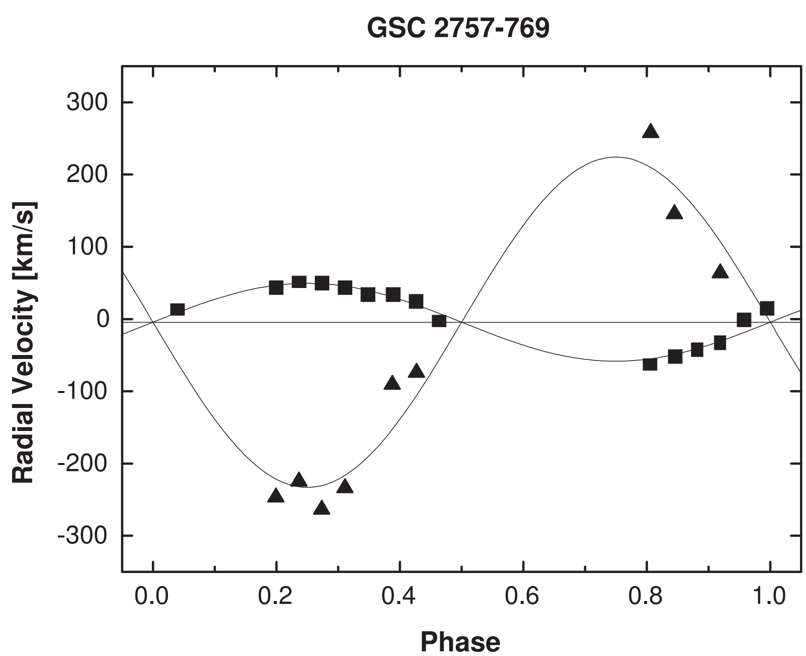

Figure 2. Radial velocities of GSC 2757-769 plotted versus orbital phase.

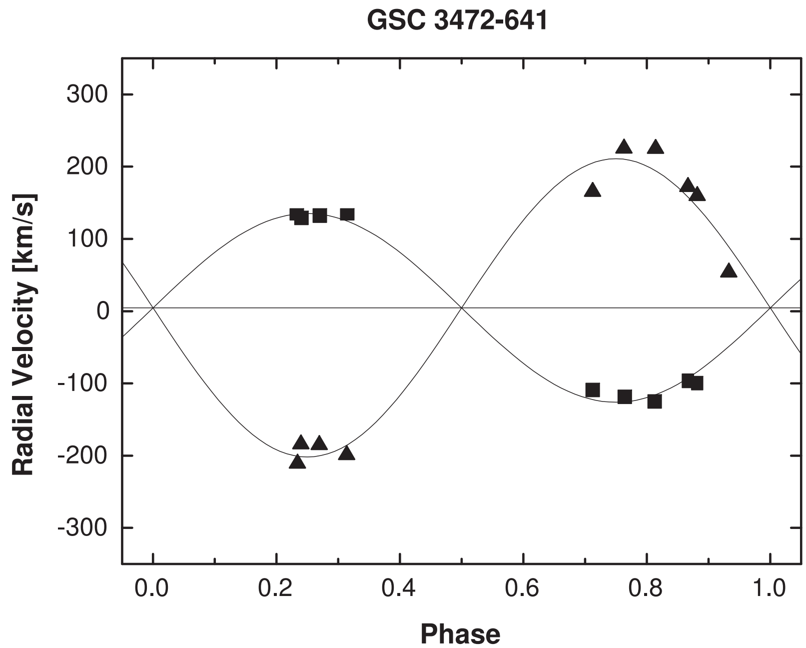

Figure 3. Radial velocities of GSC 3472-641 plotted versus orbital phase.

Table 2. Spectroscopic orbital elements

Element		BD+14°5016	GSC 2757-769	GSC 3472-641
K_1	[km s^{-1}]	54.7 ± 3.8	53.9 ± 2.4	130.7 ± 3.3
K_2	[km s^{-1}]	233.9 ± 5.6	228.6 ± 15.2	206.5 ± 8.2
γ	[km s^{-1}]	22.1 ± 5.9	-4.5 ± 10.9	4.5 ± 6.4
$q = m_2/m_1$		0.234 ± 0.022	0.236 ± 0.061	0.633 ± 0.042
$a \sin i$	[R$_\odot$]	3.63 ± 0.12	2.34 ± 0.14	2.12 ± 0.07
$a_1 \sin i$	[R$_\odot$]	0.69 ± 0.05	0.45 ± 0.02	0.82 ± 0.02
$a_2 \sin i$	[R$_\odot$]	2.94 ± 0.07	1.89 ± 0.12	1.30 ± 0.05
$m_1 \sin^3 i$	[M$_\odot$]	1.29 ± 0.12	0.80 ± 0.15	0.78 ± 0.08
$m_2 \sin^3 i$	[M$_\odot$]	0.30 ± 0.04	0.19 ± 0.03	0.49 ± 0.05

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CCD LIGHT CURVES OF ROTSE1 VARIABLES, XIX: GSC 1537:1557 Her, GSC 995:1646 Oph, GSC 1549:121 Her, AND GSC 3888:464 Dra

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Observatory and telescope:
Private observatory Schüsselacher, Wald, 0.15-m Starfire refractor

Detector:	SBIG ST-7 CCD camera

Method of data reduction:
Standard CCD-frame reduction using AIP4WIN software

Method of minimum determination:
Kwee – van Woerden algorithm

Observed star(s):				
Star name	GCVS type	Coordinates (J2000) RA	Dec	Comp./check star(s)
GSC 1537:1557 ROTSE1 J172021.58+163051.9	EW	17 20 21.6	+16 30 52	GSC 1537:1449 / GSC 1537:2349
GSC 995:1646 ROTSE1 J172156.71+095653.7	δ Sct	17 21 56.7	+09 56 54	GSC 995:1704 / GSC 995:1572
GSC 1549:121 ROTSE1 J172347.30+205441.4	EW	17 23 47.3	+20 54 41	GSC 1549:1020 / GSC 1549:293
GSC 3888:464 ROTSE1 J172622.59+535030.6	EW	17 26 22.6	+53 50 31	GSC 3888:581 / GSC 3888:404

Ephemeris:			
Star name	E 2400000+	P [day]	Source
ROTSE1 J172021.58+163051.9	52856.3954(8)	0.318275	present paper
ROTSE1 J172156.71+095653.7	52856.3880(7)	0.444630	”
ROTSE1 J172347.30+205441.4	52875.3912(8)	0.3976946	”
ROTSE1 J172622.59+535030.6	52854.5659(11)	0.316904	”

Times of minima:

Star name	Time of min. HJD 2400000+	Error	Type	Filter	$O-C$ [day]	Rem.
GSC1537:1557 (Her)	51283.8028	11	p	none		ROTSE1
	51312.9164	12	s	none		ROTSE1
	52753.4336	10	s	none		
	52753.5923	6	p	none		
	52802.4474	6	s	none		
	52812.4734	6	p	none		
	52815.4974	8	s	none		
	52856.3962	6	p	none		
	52856.5543	6	s	none		
	52898.4072	8	p	none		
GSC995:1646 (Oph)	51325.7511	7	s	none		ROTSE1
	51359.7631	9	p	none		ROTSE1
	52753.4554	18	s	none		
	52815.4806	19	p	none		
	52835.4917	19	p	none		
	52856.3888	12	p	none		
GSC1549:121 (Her)	51286.804	3	s	none		ROTSE1
	51295.7444	15	p	none		ROTSE1
	52752.5028	10	p	none		
	52753.4969	6	s	none		
	52802.4135	14	s	none		
	52812.5538	3	p	none		
	52815.5392	7	s	none		
	52835.4255	21	s	none		
	52856.5016	6	s	none		
	52871.4141	7	p	none		
	52875.3910	7	p	none		
GSC3888:464 (Dra)	52752.5207	8	p	none		
	52753.4695	15	p	none		
	52753.6316	16	s	none		
	52802.4356	15	s	none		
	52807.5013	13	s	none		
	52831.4315	12	p	none		
	52854.4050	5	s	none		
	52854.5657	15	p	none		

Explanation of the remarks in the table:
ROTSE1: Observations of Akerlof et al. (2000).

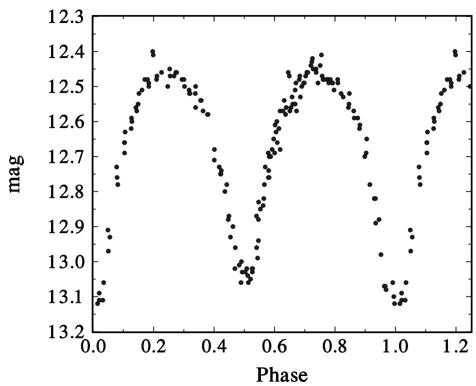

Figure 1. CCD light curve (without filter) of GSC 1537:1557

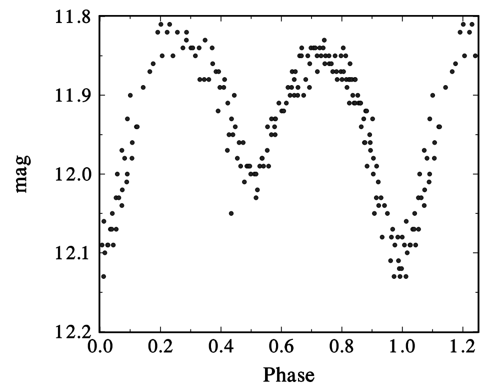

Figure 2. CCD light curve (without filter) of GSC 995:1646

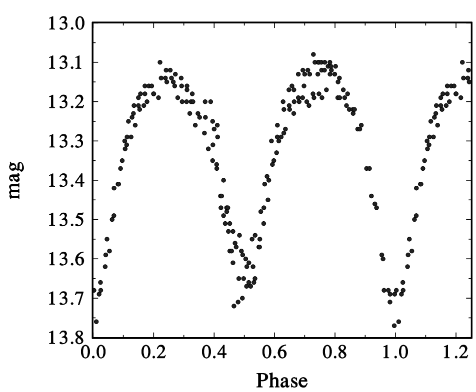

Figure 3. CCD light curve (without filter) of GSC 1549:121

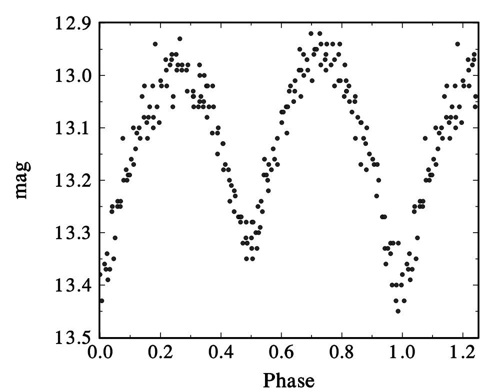

Figure 4. CCD light curve (without filter) of GSC 3888:464

Remarks:
As a byproduct of the ROTSE1 CCD survey, a large number of new variables have been discovered (Akerlof et al., 2000). In a series of papers, we report unfiltered CCD observations for some of the close binary systems (type EW) in the list of Akerlof et al. (2000). This installment contains information on four variables in the constellations Dra, Her and Oph. The four stars were observed with our CCD equipment during several nights between JD 2452752 and JD 2452898. A total of 174 CCD frames were measured of GSC 1537:1557, 183 frames of GSC 995:1646, 201 frames of GSC 1549:121 as well as 205 frames of GSC 3888:464. Figures 1 through 4 show our observations folded with the elements given in the Table of Ephemeris. These elements of variation are deduced from a linear fit to the normal minima from the ROTSE1 data and the timings of minimum derived from our data given in the table of Times of minima.

Availability of the data:
Upon request from diethelm@astro.unibas.ch

Acknowledgements:
This research made use of the SIMBAD data base, operated at CDS, Strasbourg, France

Reference:

Akerlof, C., Amrose, S., Balsano, R., Bloch, J., Casperson, D., Fletcher, S., Gisler, G., Hills, J., Kehoe, R., Lee, B., Marshall, S., McKay, T., Pawl, A., Schaefer, J., Szymanski, J., Wren, J., 2000, *AJ*, **119**, 1901

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UBVRI CCD OBSERVATIONS OF HM MONOCEROTIS AND SIXTY TWO YEAR PERIOD STUDY

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As a part of our search for solar type binaries with gas streams we observed the neglected variable, HM Monocerotis (GSC 162 265,$\alpha(2000) = 07^{\rm h}03^{\rm m}2\overset{\rm s}{.}89$, $\delta(2000) = -00°13'49\overset{\prime\prime}{.}1$). Wachmann (1968) gave 48 times of minimum light and a starting ephemeris (recalculated by us),

$$\text{HJD Tmin I} = 2430110.195\ (\pm 0.004) + 0.4076573\ (\pm 0.0000005)\text{d} \times \text{E}. \tag{1}$$

His photographic light curves show a large difference in minima, yet a smoothly changing slope in the out-of-eclipse portion, both marks of a near contact system.

Our present UBVRI light curves of HM Mon were taken at CTIO in Chile with the 0.9-m reflector on 18, 19, 20, 23 May 2001, by RGS and DRF. The CFIM 2K×2K T2K CCD camera operating in a 1K×1K quad amplifier mode for fast readouts. Standard UBVR_cI_c Johnson-Cousins filters were used. Over 180 observations were taken in each pass band. The stars (GSC 162 1551, $\alpha(2000) = 07^{\rm h}02^{\rm m}59\overset{\rm s}{.}60$, $\delta(2000) = 0°14'32\overset{\prime\prime}{.}8$) and (GSC 162 1709, $\alpha(2000) = 07^{\rm h}03^{\rm m}12\overset{\rm s}{.}16$, $\delta(2000) = 00°14'31\overset{\prime\prime}{.}1$) were used as comparison and check stars, respectively. A finding chart of HM Mon (V), the comparison (C) and check star (K) are given in Figure 1. The light curves and color curves of the variable are given in Figure 2 as normalized flux versus phase.

We were able to perform a period study with 89 times of minimum light spanning an amazing 62 years (Kreiner, Kim and Nah, 1999; BBSAG 1994, 1995, 1997). Our three mean epochs of minimum light were determined from U,B,V,R,I eclipse timings:

$$\begin{aligned}\text{HJD MIN I} &= 2452632.7926 \pm 0.0004\\ &= 2452637.6842 \pm 0.0005\\ \text{HJD MIN II} &= 2452636.6638 \pm 0.0008\end{aligned}$$

using parabola fits. We calculated the following linear ephemeris from recent epochs (after JD 2444500) which we used to phase our data:

$$\text{HJD Tmin I} = 2452632.7895\text{d}(0.0041) + 0.40765554(0.00000037)\text{d} \times \text{E}. \tag{2}$$

A weighted quadratic fit was applied to all available timings of minimum light gave:

$$\begin{array}{lcccc}\text{HJD Tmin I} = & 2452632.7888 & + 0.40765508\text{d} \times \text{E} & - 0.000000000018 \times \text{E}^2. & (3)\\ & \pm 0.0013 & \pm 0.00000014 & \pm 0.000000000002 & \end{array}$$

Figure 3 shows the $O-C$'s calculated from the linear part of equation 3 overlain by the quadratic fit (the last term). This demonstrates that equation 3 provides a good representation of the period behavior of the system. The steady period decrease it indicates is not unusual for solar type binaries undergoing magnetic breaking via stellar winds. Our $U-B$, $B-V$, $V-I$, $R-I$ color indices indicated a spectral type of about G2V $\pm$ 2 for the system, so solar type activity is expected. The check star was found to be F8V with a Vmag of 13.03 and the comp star a K2V star with V = 12.25.

In modeling the light curve we first used Binary Maker 2.0 (Bradstreet, 1992) to fit the light curves. We tried contact and near contact models. None provided satisfactory fits even with a spot. Later, I tried a V1010 Oph type with a stream spot near the L1 point on the smaller star with a large dark spot facing it on the larger component. This immediately provided an excellent fit to these otherwise difficult curves.

Using averaged starting values from Binary Maker as our input values, we calculated complete simultaneous 5 color synthetic light curve solutions with the Wilson Code (Wilson & Devinney, 1971; Wilson, 1990, 1994). Our best solution indicates that the secondary component is slightly under-filling its Roche lobe (fill-out = 99.39$\pm$0.03%) while the secondary component is filling. Other values calculated include the temperature difference, δT = 2345 K, mass ratio m_2/m_1 = 0.590 and an inclination of 75.4 degrees. The two modelled spots are as follows: a stream spot with a temperature factor of 1.46 and a radius of 13.1 degrees very near the L1 point of the secondary component and a solar-type dark spot of radius 33.1 degrees with a T factor of 0.92. Another solution was obtained in a contact mode (presented at the January 2004 AAS meeting, Dudles et al. 2003) with a cool third light. But the goodness of fit parameters were about 3 times worse and the fit was questionable.

Our best solution is shown overlaying the data in Figure 1. A geometrical representation of HM Mon with the two spots is given in Figure 4 as viewed from the pole.

Only after many trails did we understand the correct modeling configuration. The difficulties in the modeling undoubtedly arose from the dominating character of the spots. The stream spot persisted through the entire set of differential corrections iterations (hundreds) and is undoubtedly real. This system is probably undergoing rapid evolution into contact. Good quality spectroscopic data is need to verify this these important results.

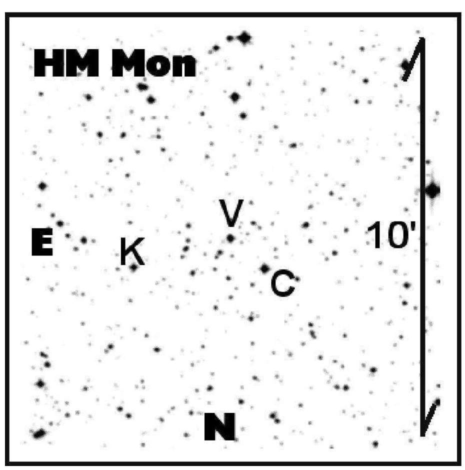

Figure 1.

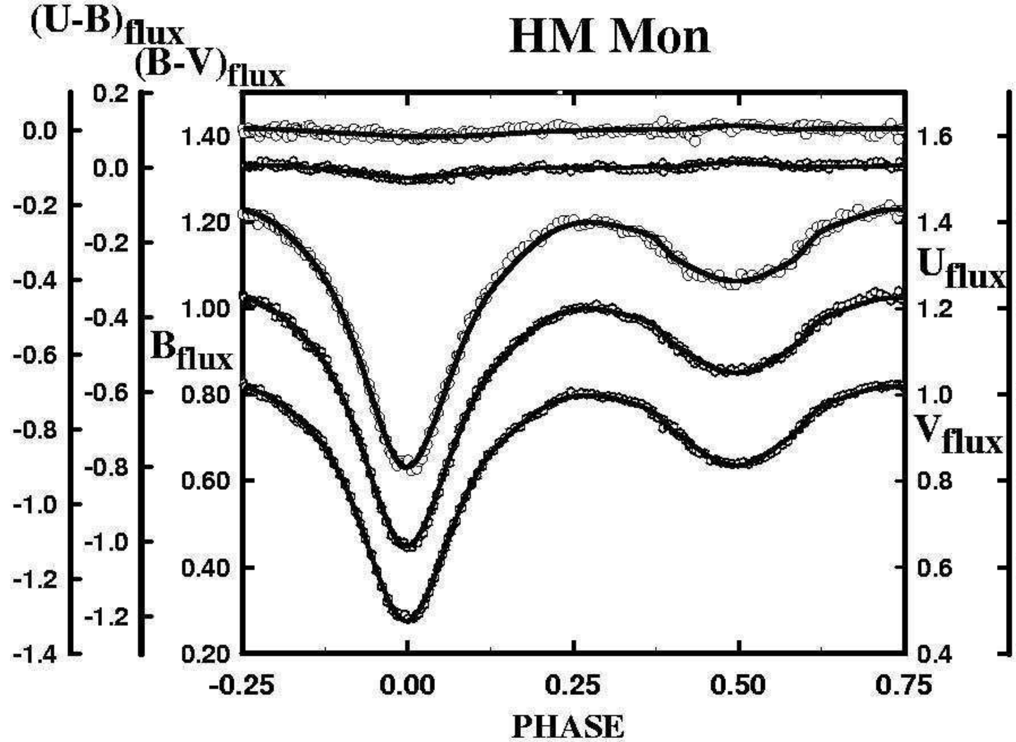

Figure 2.

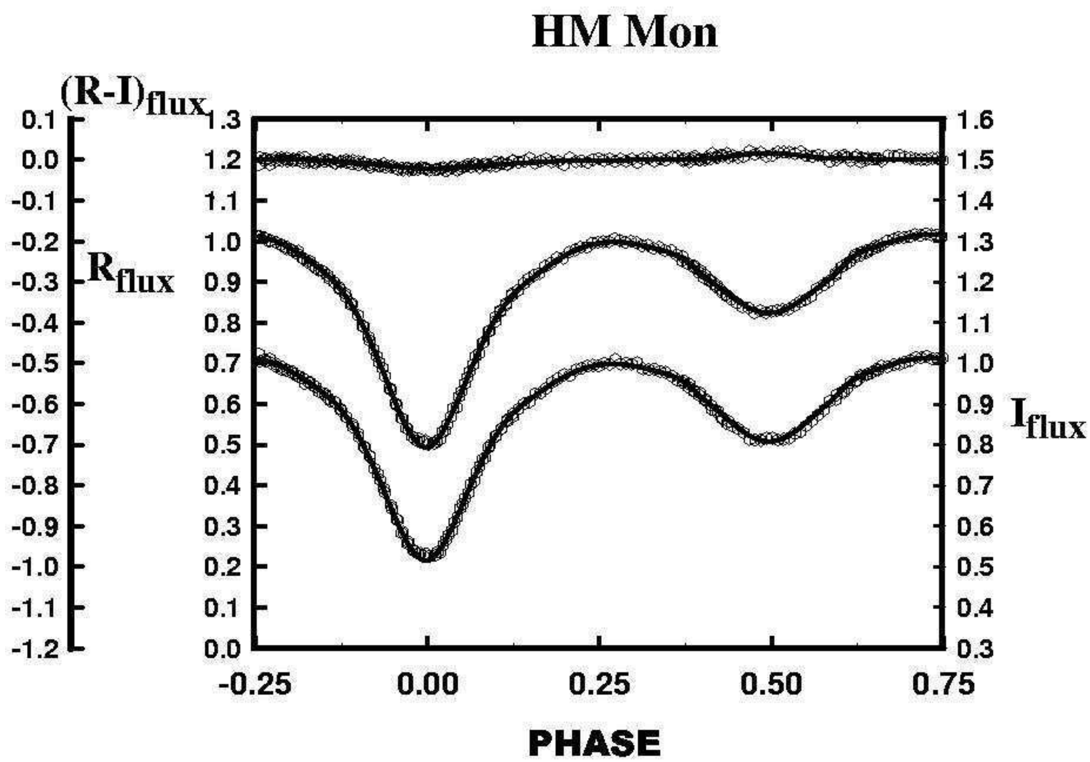

Figure 3.

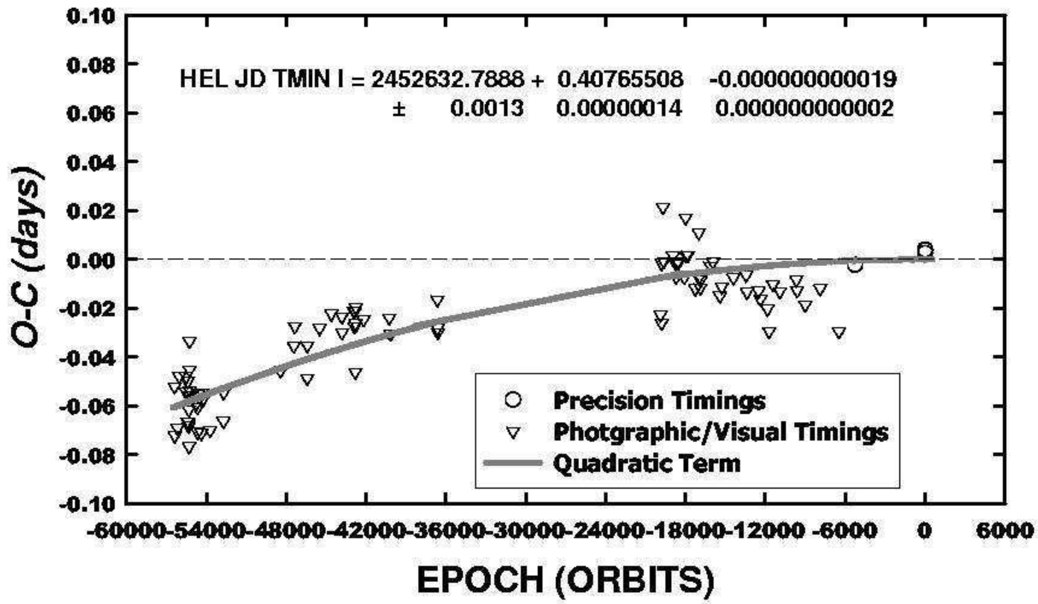

Figure 4.

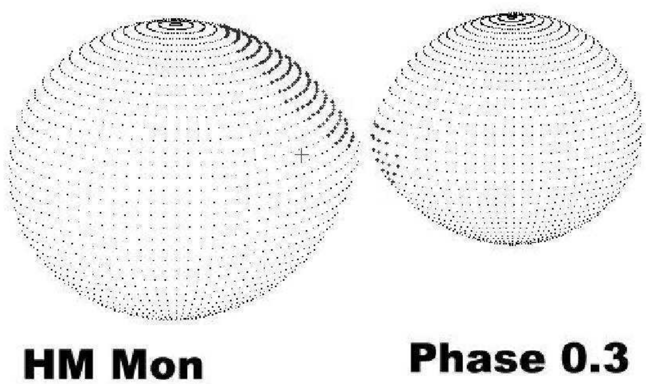

Figure 5.

We wish to thank CTIO for their allocation of observing time, and a small research grant from the American Astronomical Society which supported this run.

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MINIMA OF ECLIPSING BINARIES IN THE ASAS-2 DATABASE

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The following table contains the times of 163 normal CCD minima of 37 eclipsing binaries obtained from the ASAS-2 database (Pojmanski 1997, 2002). Observations of named eclipsing variables (GCVS, NSV, BV catalogues) from the ASAS database were divided into separate sets. The beginning and end of those terms (given in units of JD–2450000) are described in the table as 'Beg' and 'End'. Folded light curves were constructed for each term based on the ASAS orbital period. The orbital period of V514 Mon was determined based on the O-C diagram (Kreiner et al., 2001).

The times of minima given in HJD were calculated using the Kwee and van Woerden (1956) method. Some minima were determined by Kordylewski's tracing paper graphic method (Szafraniec, 1948). These are marked as 'TP'. The orbital phase of some secondary minima are shifted from 0.5, such systems are marked by 'E' in the remarks column. The number of individual points used for minimum determination is also given in the table, in the column labeled 'No'.

Based the results obtained, new ephemerides were calculated and added to an up-to-date database (Kreiner, 2004). The database can be accessed at the following web page: `http://www.as.ap.krakow.pl/ephem`.

References:

Kreiner, J.M., Kim, C.H., Nha, I.S., 2001, *An Atlas of O-C Diagrams of Eclipsing Binary Stars, vols. I-VI* **Editor:** Wydawnictwo Naukowe Akademii Pedagogicznej w Krakowie, `http://www.as.ap.krakow.pl/o-c/index.html`

Kreiner, J.M., 2004, in preparation

Kwee K.K., van Woerden, H., 1956, *BAN*, **12**, 327

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Szafraniec, R., 1948, *Acta Astron. ser. C*, **4**, 81

Star	Period	Typ	Beg	End	No	HJD	Error	Remarks
DD Aqr	0.721005	pri	1069	1149	63	2451091.8558	0.0004	
		sec	1046	1158	74	2451092.2159	0.0005	
		pri	1290	1375	41	2451342.0452	0.0004	
		sec	1291	1374	64	2451342.4037	0.0009	
		pri	1394	1521	81	2451446.5920	0.0002	
		sec	1395	1520	136	2451446.9506	0.0004	
HS Aqr	0.710199	pri	1069	1133	23	2451091.6813	0.0004	
		sec	1046	1137	37	2451091.3267	0.0005	
		pri	1257	1321	26	2451299.7666	0.0003	
		pri	1331	1491	39	2451353.7407	0.0003	
		sec	1327	1374	42	2451353.3861	0.0004	
		pri	1395	1486	60	2451431.8616	0.0005	
		sec	1394	1502	56	2451431.5113	0.0004	
V1269 Aql	2.00165	pri	1069	1475	214	2451337.5742	0.0005	
		sec	1046	1488	284	2451338.5722	0.0002	
SV Cen	1.657486	sec	0558	0823	10	2450576.8738	0.0061	
		pri	1109	1401	16	2451232.4796	0.0041	
		sec	1143	1397	16	2451231.6587	0.0021	
		sec	1526	1549	7	2451541.6431	0.0058	
BF Cen	3.6934	pri	0547	0562	15	2450558.7950	0.0014	
		sec	0549	0582	30	2450556.9475	0.0031	
		pri	1112	1367	29	2451238.3685	0.0010	
		sec	1114	1395	35	2451236.5238	0.0011	
		pri	1518	1555	12	2451533.8332	0.0011	
		sec	1520	1561	13	2451531.9907	0.0065	
IV Cen	19.131001	pri	1159	1332	13	2451217.408	0.018	:
		sec	1130	1284	12	2451226.930	0.023	
		pri	1484	1562	23	2451523.630	0.013	
KT Cen	4.130546	pri	0547	0568	11	2450560.138	0.011	E
		sec	0549	0582	12	2450557.7984	0.0052	
		pri	1113	1369	17	2451225.1743	0.0061	
		sec	1127	1375	23	2451222.7991	0.0045	
		pri	1534	1535	11	2451534.964	0.019	:TP
LT Cen	1.625932	sec	0546	0582	34	2450559.6416	0.0012	
		pri	0550	0568	22	2450560.4556	0.0014	
		sec	1136	1364	28	2451237.6480	0.0005	
		pri	1114	1329	24	2451238.4601	0.0011	
		sec	1484	1562	17	2451533.5619	0.0022	
		pri	1488	1553	11	2451534.3717	0.0013	
MN Cen	3.489266	pri	0549	0563	36	2450560.2024	0.0013	
		sec	0551	0582	26	2450561.9560	0.0026	
		pri	1114	1397	31	2451237.1029	0.0021	
		sec	1116	1399	33	2451235.353	0.016	TP
MO Cen	9.656892	pri	0551	0562	22	2450562.200	0.023	
		sec	0547	0567	37	2450557.4239	0.0061	
		pri	1112	1373	35	2451238.1702	0.0091	
		sec	1116	1397	41	2451233.4894	0.0048	:
		pri	1479	1556	19	2451537.544	0.027	:
		sec	1475	1562	40	2451532.7503	0.0074	:
MP Cen	2.992891	pri	0549	0582	33	2450558.5587	0.0014	
MQ Cen	3.687641	pri	0549	0582	38	2450560.5199	0.0040	
		sec	0547	0565	20	2450558.6677	0.0030	
		pri	1120	1397	45	2451238.9100	0.0017	
		sec	1111	1399	37	2451237.0697	0.0063	
		pri	1520	1561	11	2451533.8650	0.0052	
		sec	1518	1555	12	2451532.0305	0.0041	

Star	Period	Typ	Beg	End	No	HJD	Error	Remarks
MR Cen	3.913546	sec	0552	0583	36	2450560.0662	0.0031	
		pri	1113	1395	38	2451227.3391	0.0033	
		sec	1119	1401	41	2451229.3004	0.0040	
		pri	1469	1555	11	2451528.7009	0.0050	
		sec	1475	1553	17	2451530.647	0.016	
V343 Cen	0.587651	pri	0547	0583	46	2450560.7784	0.0012	
		sec	0549	0583	59	2450561.0698	0.0017	
		pri	1114	1403	54	2451237.1714	0.0006	
		sec	1118	1395	77	2451237.4745	0.0011	
		pri	1492	1562	23	2451535.1126	0.0025	
		sec	1497	1560	13	2451535.4116	0.0013	
V346 Cen	6.322368	sec	0547	0560	12	2450560.744	0.011	
		pri	0552	0583	11	2450558.7060	0.0054	:
		sec	1116	1395	19	2451230.8552	0.0047	:
		pri	1114	1399	30	2451235.1575	0.0023	:
		sec	1521	1553	7	2451528.016	0.022	:
		pri	1506	1544	8	2451532.341	0.029	:
V384 Cen	12.6320	pri	1118	1346	18	2451232.3713	0.0071	
V440 Cen	2.676421	pri	0552	0568	16	2450558.1732	0.0039	:
		sec	0548	0583	13	2450559.7030	0.0057	:
V916 Cen	1.463279	pri	0549	0568	28	2450559.7535	0.0012	
		sec	0551	0582	23	2450560.4589	0.0030	
		pri	1112	1367	39	2451237.2133	0.0022	
		sec	1117	1397	39	2451237.9453	0.0014	
		pri	1488	1560	19	2451534.2477	0.0061	
		sec	1518	1562	26	2451534.968	0.011	
BV1420	2.52473	pri	0552	0582	15	2450560.1595	0.0027	
(Cen)		sec	0551	0566	8	2450559.0120	0.0016	
		pri	1145	1375	25	2451256.9820	0.0038	
		sec	1144	1341	17	2451255.8653	0.0013	
NSV 5335	1.25092	pri	0551	0567	13	2450731.6839	0.0062	
(Cen)		sec	0549	0583	16	2450731.0278	0.0075	
VZ Cru	1.125872	pri	0552	0563	11	2450561.5214	0.0010	
		sec	0550	0583	13	2450560.9565	0.0005	
		pri	1136	1402	21	2451261.7777	0.0011	
		sec	1132	1335	21	2451261.2127	0.0022	
RW Dor	0.285465	pri	0546	0582	16	2450559.9437	0.0004	
		sec	0548	0583	16	2450560.0865	0.0003	
		pri	1026	1208	49	2451158.5603	0.0002	
		sec	1070	1246	39	2451158.7027	0.0002	
		pri	1354	1561	72	2451505.6820	0.0002	
		sec	1355	1562	69	2451505.8252	0.0002	
TY Men	0.461666	pri	1156	1320	203	2451215.1809	0.0002	
		sec	1155	1335	217	2451214.9535	0.0001	
		pri	1368	1430	49	2451403.5411	0.0002	
		sec	1365	1427	29	2451403.3141	0.0005	
		pri	1440	1562	243	2451493.1040	0.0001	
		sec	1438	1562	252	2451492.8764	0.0001	
BV1526	2.3446345	pri	0547	1438	11	2451112.7429	0.0021	
(Men)		pri	1492	1560	15	2451523.0544	0.0016	
		pri	1462	1551	8	2451504.6710	0.0040	
CF Mon	2.610422	pri	1081	1251	32	2451165.3090	0.0022	E
		sec	1085	1247	30	2451166.6760	0.0032	:
DD Mon	0.568018	pri	1065	1283	109	2451174.4179	0.0002	
		sec	1079	1302	98	2451174.1343	0.0001	
		pri	1440	1560	48	2451503.8698	0.0003	
		sec	1430	1558	62	2451503.5849	0.0004	

Star	Period	Typ	Beg	End	No	HJD	Error	Remarks
KR Mon	1.150966	pri	1069	1333	97	2451189.6176	0.0002	E
		sec	1080	1314	81	2451189.0395	0.0004	
		pri	1442	1562	35	2451511.8826	0.0010	
		sec	1439	1560	35	2451511.3048	0.0020	
V450 Mon	2.597009	pri	1045	1149	54	2451116.1809	0.0018	E?
		sec	1075	1156	73	2451114.8896	0.0011	
		pri	1157	1313	92	2451201.8825	0.0013	
		sec	1158	1304	86	2451200.5893	0.0012	
		pri	1440	1549	45	2451503.1348	0.0017	
		sec	1423	1561	69	2451501.8426	0.0013	
V514 Mon	0.55737224	pri	1074	1170	130	2451128.9232	0.0002	
		sec	1065	1169	141	2451128.6425	0.0008	
		pri	1174	1305	140	2451214.1997	0.0002	
		sec	1175	1299	155	2451213.9266	0.0004	
		pri	1415	1561	137	2451501.8111	0.0004	
		sec	1417	1558	111	2451501.5305	0.0004	
V681 Mon	5.757346	pri	1170	1320	50	2451205.3811	0.0021	
		sec	1116	1328	164	2451202.4820	0.0016	
		pri	1458	1556	15	2451510.5261	0.0031	
		sec	1438	1558	80	2451507.631	0.012	
TV Mus	0.445664	pri	0550	0568	25	2450564.0647	0.0010	
		sec	0547	0582	22	2450563.8453	0.0009	
		pri	1193	1364	33	2451267.7720	0.0007	
		sec	1196	1366	26	2451267.5496	0.0006	
		pri	1512	1562	15	2451543.6358	0.0019	
		sec	1519	1562	14	2451543.4180	0.0023	
V502 Oph	0.453391	pri	1221	1290	76	2451267.1421	0.0003	
		sec	1228	1288	69	2451266.9174	0.0002	
		pri	1294	1348	75	2451320.6436	0.0004	
		sec	1296	1348	82	2451320.4155	0.0002	
		pri	1359	1448	40	2451389.1042	0.0002	
		sec	1361	1451	32	2451388.8781	0.0005	
WY Sgr	4.670016	pri	1025	1450	22	2451170.2943	0.0019	
		sec	0560	1476	45	2451172.6393	0.0026	
V792 Sgr	3.931536	pri	1229	1363	27	2451296.3500	0.0055	
		sec	1227	1353	23	2451298.3011	0.0066	
		pri	1394	1476	12	2451430.003	0.023	
		sec	1396	1471	13	2451431.961	0.014	
V1071 Sgr	1.356116	pri	0559	0582	6	2450567.793	0.013	:
		pri	1230	1480	20	2451343.4885	0.0018	
		sec	1266	1482	15	2451344.1669	0.0016	
FW Vel	2.383640	pri	1463	1492	50	2451483.1185	0.0021	
		sec	1469	1493	49	2451484.3128	0.0012	
		pri	1499	1518	70	2451506.9526	0.0007	
		sec	1498	1517	103	2451508.1432	0.0007	
		pri	1518	1542	20	2451530.7852	0.0028	
		pri	1549	1561	9	2451552.2390	0.0019	
		sec	1548	1562	17	2451553.4338	0.0024	
V356 Vel	1.767397	pri	1508	1554	42	2451517.5744	0.0008	
		sec	1500	1560	65	2451518.4583	0.0012	

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SPECTROSCOPIC CLASSIFICATION OF A SUSPECTED SU UMa STAR IN LIBRA

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During the REU (Research Experiences for Undergraduates) observation campaign at CTIO (Cerro Tololo Inter-American Observatory) in February 2004, the VSNET alert 7982 by Pojmanski was received, indicating the outburst of a new eruptive star (with designation ASAS 153616-0839.1) in Libra. Light curves taken all over the world revealed that the object showed periodic variability with probably increasing period (Kiyota, 2004), which could thus been interpreted as growing superhumps with a final period of $P_{sh} = 0.06501(3)$ d (Kato, 2004).

We observed the object in low resolution with the R-C spectrograph at the 1.5 m telescope at CTIO, see Table 1 for the details. Standard data reduction was performed with IRAF including bias and flatfield correction and wavelength calibration. The standard star HR 3454 has been used to correct for the instrument curve. The spectra have a resolution of 1.5 nm and cover the range of 370–970 nm. Since we did not find variations in the spectra (apart from the increasing brightness), we averaged them to increase the S/N. All subsequent analysis of the data has been done using MIDAS.

In Fig. 1, the average spectrum of the two nights is plotted. Note that the flux values should be taken as relative values only, the absolute flux calibration is just a rough estimate. The spectrum is given as observed, without correction for interstellar reddening. It shows a very blue continuum, with the characteristic dwarf nova lines (hydrogen and

Table 1: Observational details of the individual spectra.

Date	UT start	Exp-time [s]
2004-02-09	08:25:57.5	900
2004-02-09	08:42:09.4	900
2004-02-10	07:40:11.9	900
2004-02-10	08:56:04.4	900

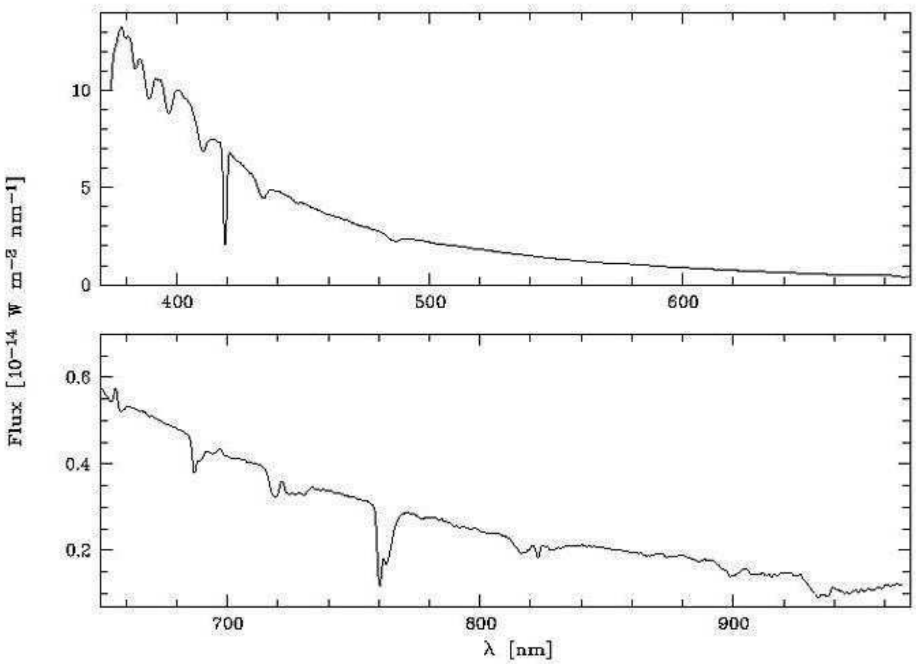

Figure 1. The spectrum is dominated by a very blue continuum and the hydrogen lines in absorption. The feature at $\lambda = 418$ nm is due to a CCD artefact. The spectrum thus confirms the classification as a dwarf nova in outburst.

helium) present as broad absorption features, indicating an optically thick disc of high temperature.

We have tried to fit a λ^α power law to the blue part of the spectrum, leaving out the line features, and determined $\alpha = -4.5(2)$. The spectral energy distribution is thus much bluer than expected for a steady state disc; for comparison, Lynden–Bell (1969) calculates the maximum slope to be $\lambda^{-7/3}$. Furthermore, the fit showed clearly that a single power law is not sufficient to fit even the blue slope of the continuum. This is not surprising, if we assume the system to be of SU UMa type. The superhump during the outburst phase gives an additional blue contribution to the continuum, which is thus no longer disc dominated.

To check for other, weaker lines and in search for emission features, we normalised the spectrum using high order splines. A part of this normalised spectrum is plotted in Fig. 2. The emission core of Hα is clearly visible in the broad absorption trough, as is emission of He II at 468.6 nm blended with the Bowen emission feature at 464 nm. He I is present in absorption at $\lambda = 402.6$ nm (outside plotted range), 447.1 nm, 492.1 nm (barely visible in the red flank of Hβ) and 667.8 nm. A broad emission feature centred on 584 nm is probably caused by C IV/N IV blended with He I and the nearby Na D line in absorption. The half width of this emission feature is about 3400 km/s indicating that the origin of these highly ionised lines either lies in the boundary layer between the accretion disc and the white dwarf surface or at least in the very inner region of the accretion disc. The FWHM and the equivalent width of the main absorption features are given in Table 2.

We have compared our spectrum to those of other dwarf novae in outburst. Mennickent et al. (2002) published an analysis of V592 Her during its outburst in August 1998 and their average spectrum looks very similar to ours. However, it shows a slightly less blue

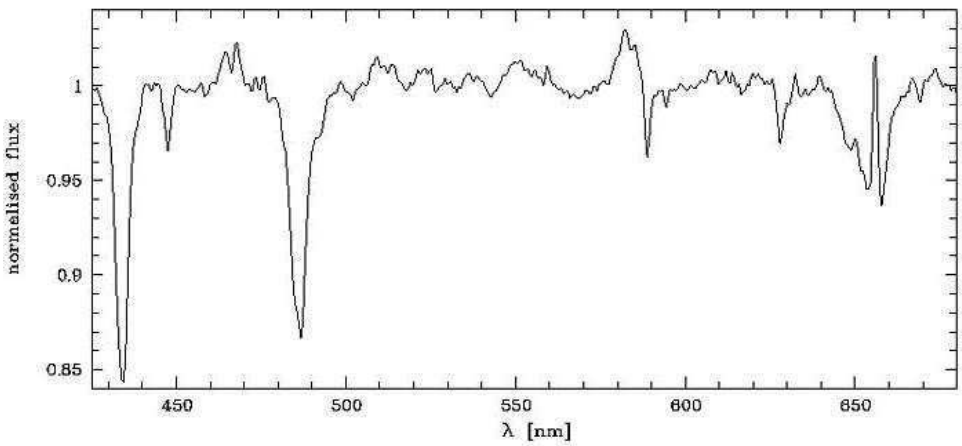

Figure 2. In the normalised spectrum, the weak lines like Hα, He I (447.1 nm), He II (468.6 nm) blended with Bowen-blend, or N IV/C IV(583 nm) blended with Na D in absorption become more apparent. The line at $\lambda = 628.3$ nm is of atmospheric origin.

continuum ($\alpha = 3.50(1)$), the absorption lines are narrower, and emission cores of He I are found in the absorption troughs. This behaviour can be explained with ASAS 153616-0839 having a higher temperature and thus a thicker disc.

Similar spectra have also been obtained of WZ Sge during the first days of its super-outburst in 2001 (Nogami & Iijima, 2004). Except for the double–peaked line–profile of He II and Hα, whose separation of 780 km/s would be below the detection limit of our resolution, and the absence of He II at 541.1 nm in our spectrum, their average spectrum from day 1–5 resembles the spectrum of ASAS 153616-0839. However, the spectra of WZ Sge evolved very rapidly during the outburst. After day 5, emission cores became visible for Hβ and later also for the other blue Balmer lines as well as for He I, while the emission features of He II and N IV/C IV disappeared. The similarity to the first spectra would thus indicate that our observations have been taken during the beginning of the super-outburst. This is consistent with the photometric observations, as the superhumps were still evolving in this epoch.

To summarise this investigation, we would like to state that the spectra of ASAS 153616-0839 confirm its photometric classification as a cataclysmic variable of SU UMa type. Although rather blue, they are consistent with spectra observed during early outburst phases of similar systems. The FWHM of the lines indicate that the system is seen at high inclination. As it has not been known before the outburst, but should be reasonably bright also in quiescence, it will present an interesting object for further studies.

Table 2: The full width of half maximum and the equivalent width (both in nm) are listed for the main absorption lines in the spectrum.

	H_9	H_8	Hϵ	Hδ	Hγ	Hβ	He I 402.6	He I 447.1	Na D
FWHM	2.38	2.92	3.03	4.06	4.13	5.75	1.03	2.45	2.18
W	0.22	0.40	0.47	0.99	0.72	0.79	0.015	0.088	0.071

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DISCOVERY OF THE SECONDARY IN THE SPECTRUM OF THE SB1 SYSTEM HD 861

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This star (HD 861, SAO 11044, HIP 1063, BD +61 16) is a well known SB1 binary but has been rarely studied although it is quite bright and close. Duflot & Fehrenbach (1956a, 1956b) mentioned that it had variable radial velocities. The orbital elements were determined by Acker (1971) from 14 observations combined with 3 additional older observations of Boulon (1956, 1957). Its orbital elements are: $P_{\rm orb} = 11\overset{\rm d}{.}2153, K = 43.8\,{\rm km\,s^{-1}}, {\rm e} = 0.22, {\rm V_0} = -12.5\,{\rm km\,s^{-1}}, \omega = 21\overset{\circ}{.}0$. It was classified as A2 based on the CaIIK line and as F2 based on the metallic lines by Slettebak & Nassau (1959). Calcium was found to be underabundant by about 0.4dex by Künzli & North (1998) who also determined the following parameters: $v \sin i = 35\,{\rm km\,s^{-1}}, \xi_{\rm turb} = 3.2\,{\rm km\,s^{-1}}, {\rm T_{eff}} = 7715\,{\rm K}, \log {\rm g} = 3.9$. It is thus an Am star. Hipparcos lists $V = 6\overset{\rm m}{.}63, \pi = 8.55 \pm 0.63\,{\rm mas}$ (ESA 1997). The photometric database of Mermilliod et al. (1997) lists the UBV observations of Bouigue et al. (1961) $V = 6.64, B - V = 0.19$. Geneva photometry can be found in Rufener (1980).

Our spectroscopic observations were carried out with the 2m RCC telescope of the Bulgarian National Astronomical Observatory in the frame of our observational program on Am stars in binary systems. The Photometrics AT200 camera with a SITe SI003AB 1024×1024 CCD chip, ($24\,\mu$m pixels) was used in the Third camera of the Coudé spectrograph to provide spectra in the 6400–6500 Å region with R = 32000. The typical S/N ratio is about 300. IRAF standard procedures have been used for bias subtracting, flat-fielding and wavelength calibration. Telluric lines have been removed using spectra of hot, fast rotating stars. Wavelength calibration has the r.m.s. error of 0.005 Å. Three spectra of HD861 were used in this study. The log of observations is listed in Table 1.

Spectra No.2 and No.3 have very little time difference and were coadded to increase their S/N ratio for the display in Fig.1. The spectra are displayed over a range of wavelengths centered at 6430Å in the vicinity of CaI λ6439 line. We have chosen this line as it is almost free of blends. It is apparent that there are two systems of lines that shift in opposite directions through the spectra. While the primary spectrum shifts towards

Table 1: List of observations: Date, HJD of the beginning of the exposure, effective exposure and radial velocity of the primary and secondary.

Sp.No.	Date [dd.mm.yyyy]	HJD (2450000+)	Eff. exp. [sec]	RV1 [km s^{-1}]	RV2 [km s^{-1}]
1	30.8.2001	2152.496	7230	-26.0 ± 1.5	62.3
2	4.10.2003	2917.280	5400	-41.0 ± 1.2	92.6
3	4.10.2003	2917.348	3980	-40.4 ± 1.0	91.8

the blue there are weak sharp features which move towards the red. The latter spectral lines are illustrated by the arrows. Moreover, these weak sharp lines are seen only in the vicinity of CaI and FeI lines, although there are much stronger FeII lines from the primary that are not accompanied by such sharp fine components. The weak sharp lines thus form at a cooler place than the photosphere of the primary. The fact that the fine lines are sharper also rules out their origin in the photosphere of the primary star.

We have calculated preliminary synthetic spectra and performed an abundance analysis of the primary. For this purpose we determined the effective temperature and gravity ($T_{\rm eff} = 8130\,{\rm K}, \log {\rm g} = 3.97$) from the Geneva photometry using the calibration of Kobi & North (1990). Model atmospheres were interpolated from Kurucz (1993). The VALD atomic line database (Kupka et al. 1999) also containing Kurucz (1990) data was used to create a line list for the spectrum synthesis. A detailed spectrum synthesis of the spectral regions was accomplished using the code SYNSPEC (Hubeny et al. 1994, Krtička 1998). The synthetic spectrum was convolved with the 0.2 Å instrumental profile and with the rotational profile. We estimated the projected rotational velocity $v \sin i = 37\,{\rm km\,s^{-1}}$. Observed and synthetic spectra are compared in Fig.2. Synthetic spectrum was shifted in wavelength to match the observed spectrum. There are no predicted theoretical lines at the points that we identify with the secondary which strengthens our claims above. Radial velocities of the primary were then measured by means of the cross-correlation with this synthetic spectrum. Radial velocities of the secondary were measured from the corresponding components of CaI λ6439, CaI λ6462 lines relative to their primary component lines which were assumed to have the velocity obtained from the cross-correlation of the whole spectrum. The estimated rms error of the radial velocity of the secondary star is about 2 km s^{-1}. The velocities obtained in this way are listed in Table 1. They indicate a preliminary mass ratio of about 2. Also, we would like to point out that our radial velocities do not fit well on the predicted RV curve and more observations are under way to improve the orbital elements and determine the precise mass ratio of the system.

In summary, several independent arguments were presented to demonstrate convincingly that there are weak sharp features in the spectrum of HD861 which cannot be attributed to the primary star and that we have discovered the spectrum of the secondary which is a cooler, fainter and less massive star with considerably slower rotation than the primary.

This paper again underlines our feeling that our knowledge of bright and nearby stars is still incomplete. This is true especially for binary and multiple systems and when our knowledge is based on older photographic techniques only. Particularly photographic data involving the longer orbital periods (where the orbital Doppler shift is less or comparable to the rotational broadening of the spectral lines) and early type stars (that have few and broad lines) need to be used with caution. Our suspicion is that one might find more cases where the unresolved secondary lines and continuum may have led to previous

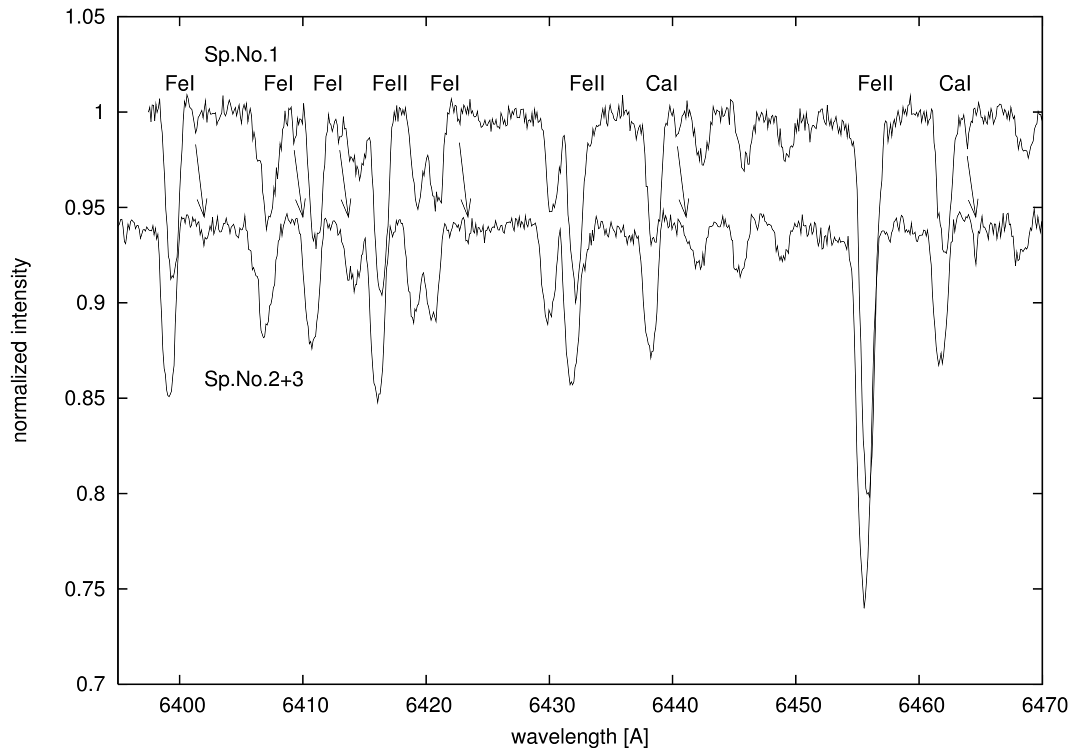

Figure 1. Two successive spectra of HD 861. While the strong lines of the primary are apparent and are shifted to the blue the fine and sharp components are sifted to the red as indicated by the arrows.

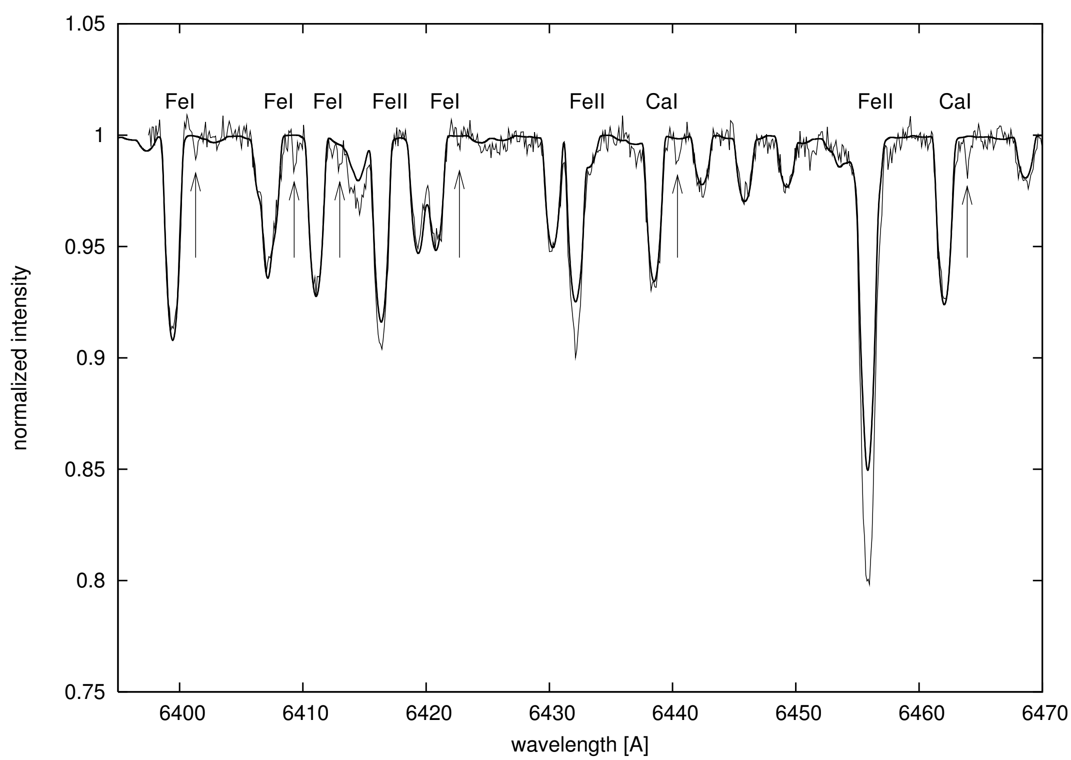

Figure 2. The observed spectrum No.1 (thin line) and the synthetic spectrum (thick line) of HD 861. Arrows indicate the position of secondary lines. There are no predicted theoretical lines at these points.

misinterpretations of the data. CCD observations with even small-medium telescopes can thus discover the binary nature or secondary spectra in many currently unresolved SB1 systems and can thus provide us with important information such as mass ratios as demonstrated recently e.g. by Faraggiana & Gerbaldi (2003), Faraggiana et al. (2001), Iliev et al. (2001a, 2001b), Budaj & Iliev (2003), Budaj et al. (2003) and Ryabchikova (1998).

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NEW MIRA TYPE VARIABLE STAR IN AQUILA

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Inspecting the region of new microquasar candidate 1RXS J190333.1+104355 (Paredes et al., 2003) I have discovered a new red variable star located in the close vicinity of this X-ray and radio source. Its coordinates measured relative to eight USNO B1.0 reference stars with the accuracy of $0\rlap{.}''28$ are $19^{\rm h}03^{\rm m}31\rlap{.}^{\rm s}960$, $+10^\circ43'53''.17$, 2000.0.

The variable star is located near the western border of ROSAT X-ray error circle (radius of $14''$), but far behind the border of the NVSS radio error circle (radius $7''$). It has a faint visual companion located $2''$SW as seen in our R band CCD frame (Figure 1).

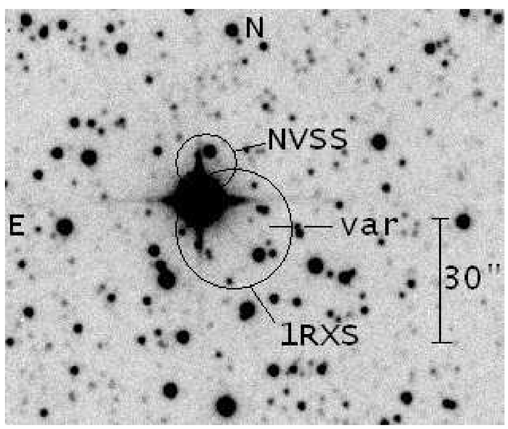

Figure 1. R band CCD image taken on 2003 September 30 showing the new variable in light minimum. X-ray and radio error circles of 1RXS J190333.1+104355 are also shown.

The sky region was monitored in June and July 2003 with CCD ST-7 in $BVRI$ bands using the 38-cm reflector of the Crimean Observatory and the 60-cm reflector of the Sternberg Institute Crimean Station. The new variable star weakened gradually from $14\rlap{.}^{\rm m}00$ to $14\rlap{.}^{\rm m}51$ in R band in the time range of JD 2452820-2452844, and from $12\rlap{.}^{\rm m}01$ to $12\rlap{.}^{\rm m}23$ in I band in the time range of JD 2452826-2452844 as seen in Figure 2. It was invisible in B and V bands. The star was detected additionally in two nights when the observations with 1-m Zeiss reflector of SAO RAN were carried out: JD 2452787, $R = 14\rlap{.}^{\rm m}28$, and JD 2452913, $R = 17\rlap{.}^{\rm m}01$, $I = 13\rlap{.}^{\rm m}83$. The registered range of variability is $14\rlap{.}^{\rm m}00$ - $17\rlap{.}^{\rm m}01$ R. The observed slow variation with the amplitude exceeding $3^{\rm m}R$ and red color suggest that it is a Mira type variable.

On 2003 July 30 we obtained a spectrum of the new variable star using the 6-m telescope BTA and a long slit spectrograph UAGS. The star was catched in the slit along with an optical candidate of the microquasar. The wavelength range was λ 4060-7920Åand the resolution 3Å. The fragment of this spectrum is shown in Figure 3. Numerous TiO bands, and Hα emission typical for Me spectrum are identified which confirm the Mira classification.

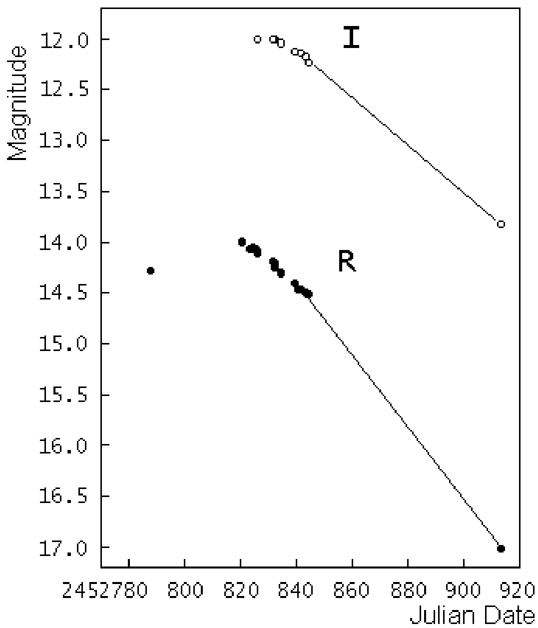

Figure 2. Light curves of new variable star in R (filled circles) and I (open circles).

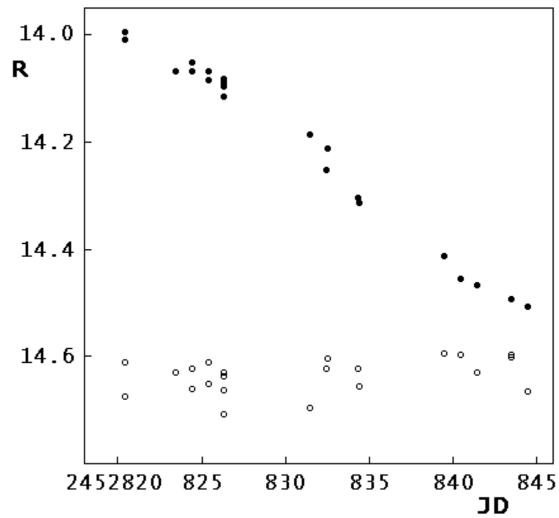

Figure 3. Fragment of light curve of new variable star (filled circles). The light curve of a red check star is shown below by open circles.

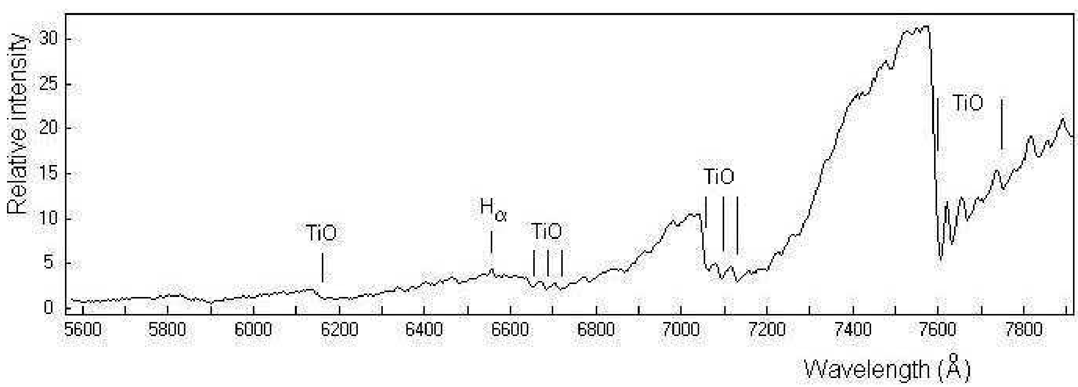

Figure 4. Spectrum of new variable star.

The observations are available through the IBVS-website as 5510-t1.txt. File includes R and I measurements of the new variable star.

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V838 Mon BEFORE AND AFTER ITS OUTBURST

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V838 Mon is a member of a new class of novae which show late K-M type spectra in outburst and do not experience the nebular stage. Two more objects of this class are known: V4332 Sgr (Martini *et al.*, 1999) and V1006/7 in M31 (Rich *et al.*, 1989). The outburst of V838 Mon in 2002 was studied by Barsukova *et al.* (2002), Bond *et al.* (2003), Crause *et al.* (2003), Kimeswenger *et al.* (2002), Munari *et al.* (2002b). Crause *et al.* (2003) report that the star underwent a deep decline and faded to $16^{\rm m}$ V in June 2002, reaching its pre-outburst magnitude, and developed a strong IR excess. The spectral energy distribution of the progenitor (at $V = 15\overset{\rm m}{.}6$) resembles an under-luminous main-sequence F star (Munari *et al.*, 2002c) or an F0III-II star (Munari *et al.*, 2002a). On the other hand, it could have been a blue star, with $B = 15\overset{\rm m}{.}85$ and $(B-V)_0 = -0\overset{\rm m}{.}03 \pm 0\overset{\rm m}{.}1$ (Barsukova *et al.*, 2002). Quite different values ($B = 15\overset{\rm m}{.}87$, $R = 14\overset{\rm m}{.}56$) were given for the progenitor by Kimeswenger *et al.* (2002). The progenitor was associated with IRAS 07015-0346, a point source detected only at $\lambda \geq 60$ μm. A B3V star is seen in the spectra of the remnant (Munari *et al.*, 2002a), along with evidence for the presence of the first known extremely cool "L supergiant" in the system (Evans *et al.*, 2003). On the base of their spectroscopy, Mikolajewski *et al.* (2003), whose direct-imaging, but not spectroscopic, results were disclaimed, speculate that the B3V star may be a blending object lying about 1000 pc behind V838 Mon, and the cool supergiant is evidently the remnant of V838 Mon outburst.

To establish the nature of the progenitor and the remnant of V838 Mon, we estimated the star's brightness using the photographic plate archives of Sonneberg Observatory and Sternberg Astronomical Institute, re-measured the B, R and I images in the DSS survey, and specially carried out $UBVRI$ CCD observations of the star during its faint state in 2002–2004. All our calibrations were based on the photometric $UBVR_CI_C$ sequence from Munari *et al.* (2002c). We used these local standard stars to calibrate a total of 41 stars lying close to V838 Mon. For flux calibrations and taking into account the interstellar reddening effect in the $UBVR_CI_C$ bands, we followed Moro & Munari (2000).

Kimeswenger *et al.* (2002) applied published color corrections to reduce DSS plate measurements to standard B and R_C bands. We used a different way to improve the DSS photometry: we selected reference stars having colors close to those of the V838 Mon progenitor, in the narrow $B-V$ range between $0\overset{\rm m}{.}45$ and $0\overset{\rm m}{.}75$. Our measurements show that about a half of surrounding stars have $B-V$ colors in this range.

The image of V838 Mon has faint close or partially merged companions. With our measuring software, we removed the distorted pixels from the star's image profile and replaced them by averaged profile values calculated assuming radial symmetry of the profile. As a result, we obtained the following mean pre-outburst values: $B = 15\overset{\mathrm{m}}{.}81 \pm 0\overset{\mathrm{m}}{.}06$, $R_C = 14\overset{\mathrm{m}}{.}84 \pm 0\overset{\mathrm{m}}{.}06$, and $I_C = 14\overset{\mathrm{m}}{.}27 \pm 0\overset{\mathrm{m}}{.}03$ ($B - V \approx 0.^{\mathrm{m}}60$ can be deduced).

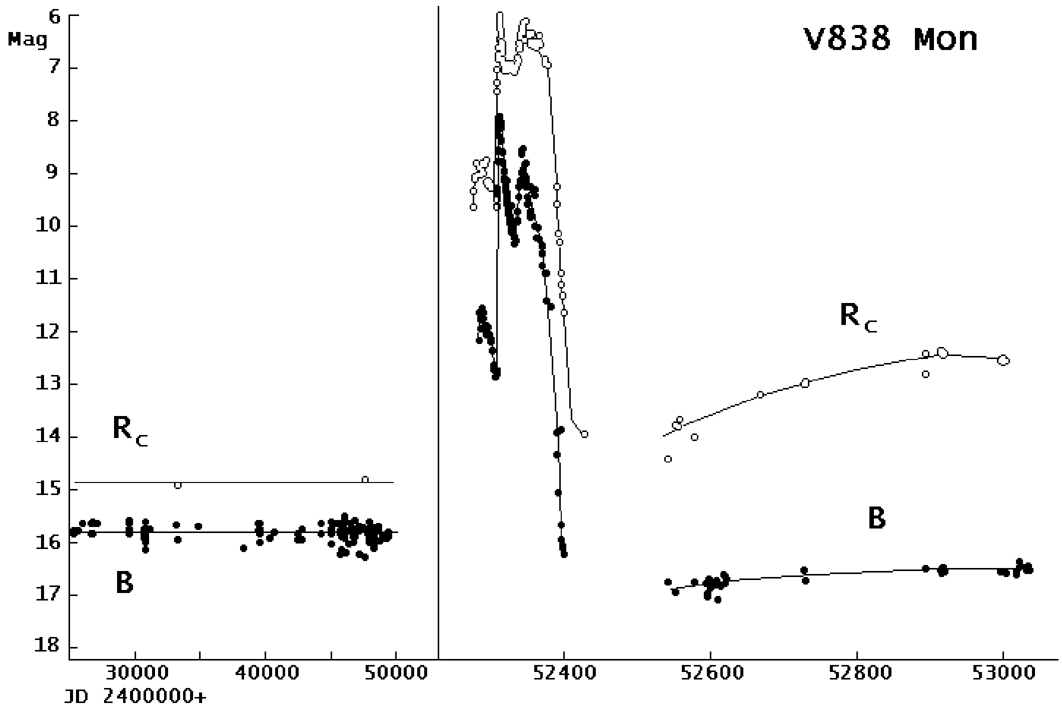

Figure 1. Archival light curves of V838 Mon and recent photometry in the B and R_C bands.

The plate archive observations of the progenitor consist of 118 eye estimates on Sonneberg plates taken between JD 2425322 and 2448329 and 26 eye estimates on Moscow plates taken between JD 2433184 and 2449394. All these estimates were done by S.Yu. Shugarov. The Moscow observations were published by Goranskij *et al.* (2002). Thus, we have followed V838 Mon during 66 years, between 1928 and 1994. All the observations are in the B band. The typical error of eye estimates is $0\overset{\mathrm{m}}{.}2$. Our photometry of the remnant includes $UBVR_CI_C$ observations using the Electron K-585 and EEV42-40 CCDs with the 100 cm Zeiss reflector of the Special Astrophysical Observatory and BVR_JI_J observations using the SBIG ST-7 and Apogee-7p CCDs with the 60 cm Zeiss reflector of the Sternberg Institute's Crimean Station. The total time range is JD 2452552–2453036. The exposure times were 10 min or shorter. Our SBIG ST-7 frames have insufficient S/N ratios in B and V bands due to poor sensitivity of this CCD at short wavelengths. Therefore, all the frames in these bands were co-added each night, giving accumulated exposure times within 40–200 min. We also consider the data from Munari *et al.* (2002a), Crause (2003), Wagner *et al.* (2003). All available observations in the B and R bands, including the outburst data (see references in Bond *et al.*, 2002), are displayed in Fig. 1.

The energy distributions of the progenitor of V838 Mon and of the remnant (October, 2003) are compared in Fig. 2 with the energy distribution for the B3V type star HD 29763 (Glushneva *et al.*, 1992) measured in the λ3325-7675Å range. HD 29763 has a low interstellar reddening, $E(B-V) = 0\overset{\mathrm{m}}{.}07$, as it can be inferred from its UBV photometry

(Mermilliod *et al.*, 2003). The JHK values for the progenitor were taken from the 2MASS IR survey, and the far IR magnitudes of the remnant are from Lynch *et al.* (2003) and Tapia & Persi (2003). Our measurements in the UV, optical, and near IR bands are also included. In Fig. 2, the $E(B-V)$ value for V838 Mon was used as a free parameter to fit its pre-outburst energy distribution with the spectrum of HD 29763, and the best fit is achieved for $0\overset{m}{.}70$. The color excess of V838 Mon is the sum of this value and the color excess of HD 29763, giving $E(B-V) = 0\overset{m}{.}77$. With this reddening, the U and B magnitudes of the remnant also fit the spectrum of HD 29763 well, but with a downward shift. Goranskii *et al.* (2002) give a smaller value, $E(B-V) = 0\overset{m}{.}63$, for V838 Mon, based on its location in the $(U-B)-(B-V)$ diagram during the outburst, when the star was red. Note that the photometric color excess, $E(B-V)$, depends on the $(B-V)_0$ color of the measured star, being larger for blue stars. This effect was studied by Straizys (1992).

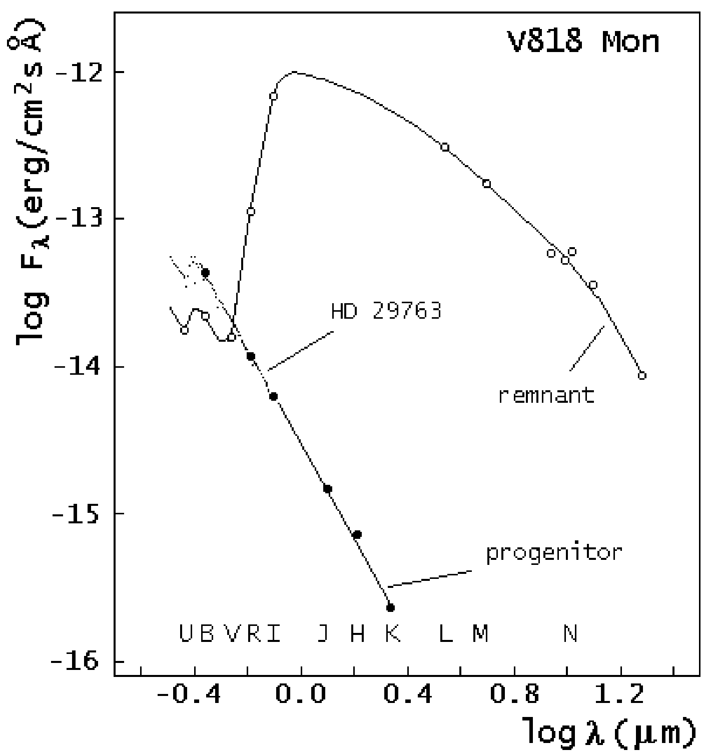

Figure 2. Comparison of the energy distributions of the progenitor and the remnant (filled and open circles) with the energy distribution of the B3V star HD 29763 (small dots).

The results of our photometric investigation are the following.

(1) The progenitor of V838 Mon is definitely a blue star, with $(B-V)_0 = -0\overset{m}{.}17 \pm 0\overset{m}{.}10$ for $E(B-V) = 0\overset{m}{.}77$. The progenitor's energy distribution consists of a single stellar blue B3 component, without any notable excess in the JHK bands, and there is no evidence for an F-type star. During the 66 years preceding the 2002 outburst, it did not show considerable variability.

(2) In October 2002, four months after the end of the optical outburst, the remnant was fainter than the progenitor by $1\overset{m}{.}1$ in the B band, but brighter in the R band (Fig. 1), in agreement with the observations by Munari *et al.* (2002a). During about 500 days after the end of the optical outburst, the remnant brightened gradually in all the bands

with the rates dependent on wavelength. The amplitudes of these brightness changes are the following: $0\overset{m}{.}1$:, $0\overset{m}{.}3$, $0\overset{m}{.}6$, $1\overset{m}{.}55$, $0\overset{m}{.}47$ respectively in U, B, V, R_C, and I_C. This brightening was noted also by Wagner *et al.* (2003) and Crause (2003).

(3) The energy distribution of the remnant is two-component, containing a stellar blue B3 component with a Balmer jump and a strong IR component of the L-type supergiant. The contribution of the cool supergiant's light to the V band can be estimated as $0\overset{m}{.}4$ in October 2003, it increases to longer wavelengths, but is small and negligible in the U and B bands.

These results contradict the conclusion by Mikolajewski *et al.* (2003) that the blue companion is a blending object, lying behind V838 Mon. Its strong brightness decay, by $1\overset{m}{.}1$ in the B filter, apparently coincided with the outburst event. V838 Mon is a binary system which consists of a blue companion and a cool supergiant. The companion that became a supergiant is invisible in the progenitor's spectrum or mimics a B-type star.

Availability of the data. Our observations are available through the IBVS web site as 5511-t1.txt . The file includes the Sonneberg archive data in Table 1A, the measurements of the DSS plates in Table 2A, the UBV photometry in Table 3A, the Cousins RJ photometry in Table 4A, the Johnson RJ photometry in Table 5A, and the $UBVR_CI_C$ photometry of surrounding stars in Table 6A.

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NEW NORTHERN CEPHEIDS

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A search for Cepheid variables was conducted in the publicly available data of the Northern Sky Variability Survey (NSVS, Wozniak et al., 2004, also see `http://skydot.lanl.gov/nsvs`). All NSVS fields with Galactic latitude $< |10|$ degrees were searched for candidates with both a sufficient number of observations to enable analysis and also with a significantly higher standard deviation than normal for their magnitude.

This resulted in the discovery of 40 previously unknown Cepheids, six of which are misclassified GCVS variables, and one was confirmed to be a Cepheid. One star was found during a test of the procedure in a field further away from the Galactic plane.

Table 1 lists the details of the new Cepheid variables. They are identified by either their GSC 1.2 number, when available, or their USNO-B1.0 number. The coordinates are taken from either UCAC2 (U; Zacharias et al., 2004), Tycho2 (T; Høg et al., 2000) or USNO-B1.0 (B; Monet et al., 2003), in that order of priority. The third column gives the Galactic latitude, and fourth the magnitude range from NSVS (red sensitive CCD cropped by a filter at 450 and 1000 nm), then the 2MASS $J - K_s$ colour, the GCVS variability type, the epoch of maximum (JD $-$ 2450000), and the period in days. The electronic version of the IBVS also provides a link to a phase plot and to the source of the data (in the case where there are two or more NSVS synonym objects pointing to the same star, only one of these objects is referred to).

Table 2 gives GCVS and NSV cross identifications for the relevant stars. The MisV identifications refer to stars discovered to be showing variability by the MISAO project (Yoshida, 2003). Simbad denotes V1397 Cyg to be identical to IRAS 21475+5211, these are however separate objects. GSC 2418-1443 is the brighter component of the binary h5540 with a separation of $13''\!.6$.

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Table 1. New Cepheid variables

GSC/USNO	RA (J2000)	Dec	b	Mag	$J-K_s$	Type	Epoch	Period
G 4038-1585	01 21 21.06	+64 06 03.0 B	+1.4	11.5−12.0	0.94	DCEP	1447.3	4.71
G 4030-1640	01 21 42.37	+61 46 07.6 B	−0.9	12.6−13.1	0.99	DCEP	1546.5	3.76
G 4034-1188	01 23 51.73	+62 31 20.0 B	−0.1	11.7−12.1	0.90	DCEP	1378.1	6.03
G 4040-1803	01 46 31.45	+65 01 34.7 T	+2.8	10.8−11.1	0.44	DCEP	1492.0	2.113
G 4041-0264	02 14 24.76	+65 35 58.1 B	+4.1	11.8−12.4	0.71	DCEP	1522.7	5.03
G 3706-0233	03 14 54.54	+55 52 49.0 B	−1.5	11.9−12.3	0.89	DCEP	1401.9	3.22
G 3729-1127	03 48 25.69	+59 26 32.2 T	+3.9	10.0−10.5	0.90	DCEP	1473.8	5.07
G 3725-0174	03 56 22.43	+57 15 26.4 B	+2.9	11.9−12.2	0.58	DCEP	1495.1	3.09
G 3721-0495	03 57 29.74	+54 56 17.2 B	+1.2	11.2−11.7	0.84	DCEP	1493.9	8.2
B 1427-0131719	03 59 38.14	+52 47 26.6 B	−0.2	13.1−13.8	1.23	DCEP	1540.2	3.71
G 3722-0763	04 01 31.01	+55 02 43.5 B	+1.7	11.9−12.3	0.98	DCEP	1451.1	6.60
G 4072-0498	04 02 36.50	+64 26 52.9 B	+8.8	12.2−12.7	0.86	CWA	1488.2	12.3
B 1422-0133818	04 02 45.09	+52 12 17.5 B	−0.3	13.3−14.0	0.98	DCEP	1544.5	4.16
G 3726-0565	04 03 46.42	+57 14 51.9 B	+3.5	11.6−12.1	0.80	DCEP	1521.9	5.12
G 3732-0183	04 30 18.69	+53 56 24.6 B	+3.8	11.9−12.4	0.68	DCEP	1538.9	6.6
G 3346-0820	04 30 33.49	+48 04 42.7 U	−0.2	13.4−14.0	1.16	DCEP	1424.2	4.56
G 2413-1025	05 46 04.52	+34 45 28.1 U	+3.1	12.3−12.8	0.85	DCEP	1514.7	4.69
G 2418-1443	05 52 58.79	+36 23 37.2 U	+5.2	10.1−10.4	0.56	DCEP	1543.6	7.85
G 0754-1993	06 40 37.56	+11 43 38.9 U	+3.0	11.7−12.1	0.81	DCEP	1512.9	4.98
B 0978-0137047	06 45 33.74	+07 48 58.6 U	+2.3	12.7−13.4	0.51	DCEP	1602.7	2.43
G 2063-0653	16 53 08.65	+25 58 35.0 U	+36.5	9.9−10.2	0.52	CWA	1424.7	9.7
G 1049-1505	19 09 31.20	+11 48 54.5 U	+1.4	12.4−12.9	1.05	DCEP	1478.5	20.9
G 1603-0820	19 19 53.15	+17 14 25.7 U	+1.7	10.8−11.3	0.98	DCEP	1497.4	4.84
G 1050-0485	19 20 36.20	+12 47 37.4 U	−0.5	11.9−12.5	1.22	DCEP	1450.1	18.3
B 1091-0397807	19 29 24.97	+19 09 23.1 U	+0.6	13.0−13.7	1.01	DCEP	1487.2	6.13
B 1124-0469482	19 41 51.10	+22 24 13.0 U	−0.3	11.9−12.6	1.22	DCEP	1568.8	19.9
G 2145-0344	19 58 53.51	+24 23 42.3 U	−2.7	10.6−11.2	0.79	DCEP	1336.5	5.63
G 2679-0277	20 13 56.21	+35 19 41.5 U	+0.5	11.2−11.9	1.13	DCEP	1484.5	11.6
G 2683-3724	20 14 39.72	+35 39 14.5 U	+0.5	11.8−12.1	1.17	DCEP	1505.6	9.5
G 3179-0815	20 51 00.83	+43 08 23.6 U	−0.7	11.7−12.1	1.08	DCEP	1350.2	8.7
G 3575-3670	20 51 27.85	+46 18 13.5 B	+1.3	11.9−12.4	0.81	DCEP	1494.4	3.16
G 3967-3180	21 34 03.48	+53 18 36.3 B	+1.1	12.1−12.5	0.80	DCEP	1368.0	4.56
G 3971-1155	21 34 54.63	+55 56 32.2 B	+3.0	12.9−13.4	0.77	DCEP	1525.4	6.7
G 3616-1143	21 48 06.66	+51 15 30.5 B	−1.9	11.5−12.1	1.03	DCEP	1473.3	11.9
G 3616-1891	21 49 35.52	+52 23 42.8 T	−1.1	11.2−11.5	0.87	DCEP	1583.9	4.64
G 4265-0569	22 40 10.40	+60 33 49.8 B	+1.7	11.1−11.4	0.95	DCEP	1500.2	9.0
G 4265-0193	22 48 23.07	+60 24 17.4 B	+1.1	11.6−12.0	0.79	DCEP	1490.1	4.28
G 4283-0021	23 17 51.58	+62 08 04.8 T	+1.2	10.9−11.1	0.82	DCEP:	1573.0	3.62
G 4284-0427	23 32 38.97	+63 04 09.4 B	+1.5	12.2−12.6	0.99	DCEP	1551.2	4.74
G 4009-0024	23 56 26.68	+58 01 36.8 T	−4.1	11.7−12.1	0.79	DCEP	1455.9	4.74

Table 2. Cross-identifications.

GSC/USNO	Name
GSC 4030-1640	NSV 481
GSC 4034-1188	V556 Cas
GSC 4041-0264	NSV 752
GSC 3721-0495	MisV 1223
GSC 3722-0763	MisV 1224
USNO-B1.0 1422-0133818	MU Per
GSC 2418-1443	h5540
GSC 1603-0820	NSV 11913
GSC 2145-0344	HO Vul
GSC 2679-0277	NSV 12928
GSC 2683-3724	NSV 12945
GSC 3179-0815	V1662 Cyg
GSC 3575-3670	V1533 Cyg
GSC 3967-3180	V733 Cyg
GSC 3971-1155	NSV 13796
GSC 3616-1891	V1397 Cyg
GSC 4283-0021	NSV 14486
GSC 4284-0427	NSV 14606

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ERUPTION IN THE SYMBIOTIC NOVA V1329 CYGNI

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The symbiotic nova V1329 Cyg (HBV 475), discovered by Kohoutek (1969), reached the brightness maximum $m_{pg} = 11.5$ mag (caused by the thermo-nuclear runaway) in October 1966. The pre-outburst brightness varied around $m_{pg} = 15$ mag with occasional 2.5 mag decreases, which repeated with the period of 950-959 days and were explained as the eclipses of a hot component by a red giant (Stienon et al., 1974; Grygar et al., 1979). The post-outburst UBV photometry shows a linear decrease combined with a wave-like orbital brightness variation. Schild & Schmidt (1997) improved the orbital period to 956.5 days and found from polarimetry the orbital inclination of the system to be 86±2 degrees. Fekel et al. (2001) determined reliable spectroscopic orbit of the cool giant in the system. The Gaussian deconvolution of the optical and UV emission lines (Ikeda & Tamura, 2000; Pribulla et al., 2003) allowed to determine also the orbital parameters of the hot component and find minimum masses of the white dwarf and red giant in the system to be $m_1 = 0.71 \pm 0.09$ M$_\odot$ and $m_2 = 2.02 \pm 0.41$ M$_\odot$, respectively.

New photometric observations of V1329 Cyg were obtained using the single-channel photometer installed in the Cassegrain focus of the 0.6 m telescope in the G2 pavilion of the Stará Lesná Observatory. BD+35°4294 ($V = 10.16$, $B - V = 1.07$) and BD+35°4290 ($V = 10.34$, $B - V = 1.07$, $U - B = 0.88$) were used as the comparison and check star, respectively (Hric et al., 1991). Since March 2003, V1329 Cyg has also been observed using a new 0.5 m telescope in the G1 pavilion of the Stará Lesná Observatory. The telescope is equipped with the SBIG ST-10 MXE camera mounted in Newton focus (see also Pribulla & Chochol, 2003). The observations were obtained in $UBV(RI)_c$ filters. The CCD frames were reduced in the usual way (bias and dark subtraction, flat-field correction) in MIDAS reduction package using procedures written by the first author. The brightness of the variable was determined by the aperture photometry with respect to BD+35°4294. Since the variable-comparison angular distance is about 6.′5, the extinction correction has not been applied. Since the transformation of the instrumental data to the international photometric system is quite unreliable for the emission-line objects, the $BVRI$ magnitudes were left in the instrumental system (close to Johnson-Cousins system). The U observations were shifted by –0.34 mag to be in agreement with the new photoelectric data of Arkhipova & Ikonnikova (2004). Our observations are given in Table 1.

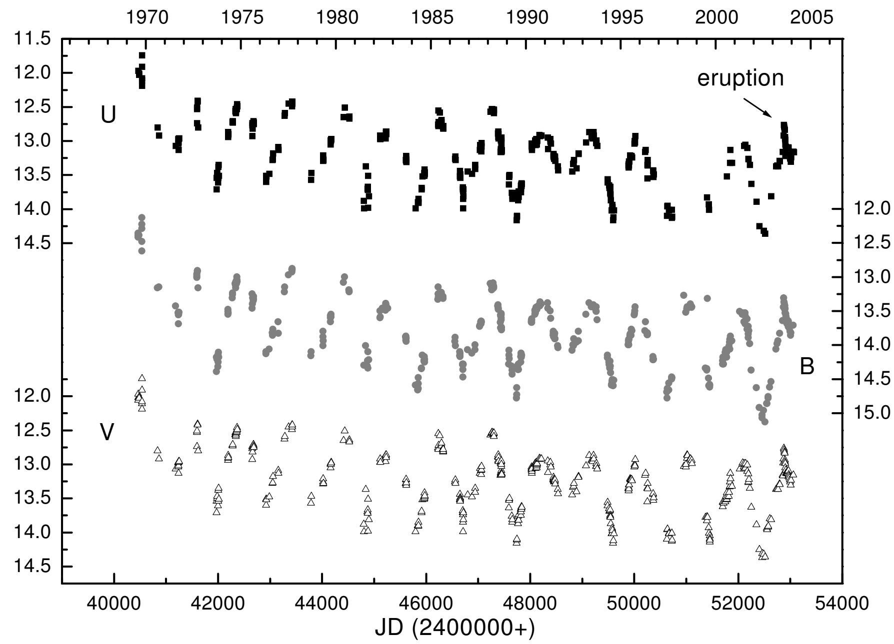

Figure 1. Historical UBV light curve of V1329 since 1969

In Fig. 1 we present the historical UBV light curve of V1329 Cyg using our new observations and data taken from Chochol et al. (1999), Skopal et al. (2002; 2004) and Arkhipova & Ikonnikova (2004).

All V observations were used to determine the ephemeris for the minima times of the orbital wave-like brightness variations. The linear decrease was removed and residuals were fitted by the 4th order trigonometric polynomial. This resulted in the following ephemeris:

$$JD_{min} = 2\,448\,676(3) + 956.0(8) \times E. \tag{1}$$

The phase light curve indicates that the maxima of the wave-like variations occur in the orbital phase 0.5.

After August 3, 2003 a rise to the maximum caused by the eruption was recorded (Fig. 2). The maximum of the eruption occurred at JD 2452876 simultaneously in all passbands. The approximate amplitudes of the brightness increases were 0.41 mag in U, 0.33 mag in B and 0.41 mag in V. The decrease to the pre-eruption brightness lasted about three months. It is no doubts that the hot component (white dwarf surrounded by the accretion disk) is responsible for the eruption.

According to the ephemeris (1) the eruption started at the orbital phase 0.37, 123 days before the expected maximum of brightness, when the hot component was in front of the cool one. Using the radial velocities of the cool component (Fekel et al., 2001) and the 956-day orbital period, we found that the time of the spectroscopic conjunction occurred 20 days after the expected maximum of brightness. Very interesting behaviour can be seen in the I passband where a small increase of brightness (corresponding to the maxima in $UBVR$) is followed by a dip lasting approximately 30 days. This could be possibly interpreted as an eclipse of the cool giant by the ejected material or by the formation of the dust in this material. The reliable analysis and interpretation of the phenomenon require the spectroscopic data taken during the eruption.

As can be seen from Fig. 1, other eruptions were not detected in photoelectric data since 1969. Although the brightness of V1329 Cyg slowly decreases since the principal maximum in 1966, the system still deserves attention both from the amateur and professional astronomers.

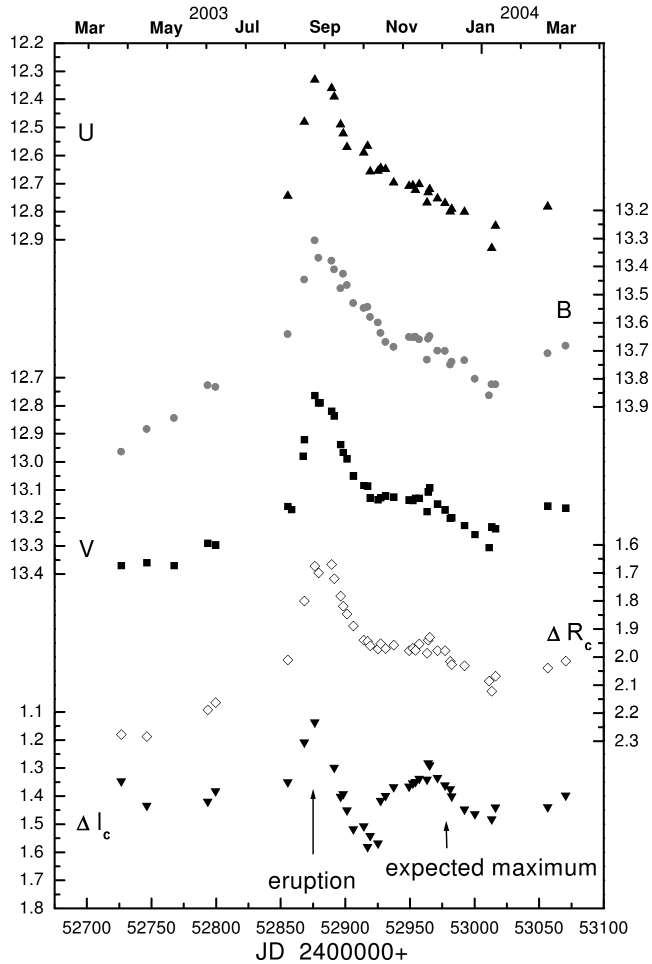

Figure 2. Recent $UBV(RI)_c$ CCD light curve of V1329 Cyg. The eruption and expected maximum of the orbital wave-like variation are denoted by arrows.

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Table 1: $UBV(RI)_c$ instrumental magnitudes of V1329 Cyg derived with respect to BD+35°4294 obtained at the G1 and G2 pavilions of the Stará Lesná Observatory. Unsure observations are denoted by ":" in the last column. The phase were computed according to ephemeris (1)

2 400 000+	Phase	U	B	V	ΔR_c	ΔI_c	Obs.
52352.622	0.846		14.63	13.89			G2
52408.509	0.904	14.16	14.92	14.25			G2
52487.381	0.987		14.96	14.32			G2:
52518.412	0.019	14.13	15.13	14.36			G2
52634.237	0.141	14.17	14.54	13.81			G2
52726.600	0.237		14.06	13.37	2.276	1.347	G1
52746.500	0.258		13.98	13.36	2.283	1.434	G1
52767.500	0.280		13.94	13.37			G1
52793.510	0.307		13.824	13.290	2.188	1.420	G1
52799.544	0.313		13.83	13.297	2.162	1.382	G1
52855.402	0.372	12.744	13.642	13.159	2.011	1.350	G1
52868.328	0.385	12.48	13.447	12.921	1.801	1.209	G1
52876.338	0.394	12.33	13.308	12.764	1.677	1.137	G1
52879.308	0.397		13.37	12.79	1.70		G1
52889.409	0.407	12.36	13.38	12.82	1.67		G1:
52891.362	0.410	12.39	13.411	12.836	1.721	1.299	G1
52896.356	0.415	12.49	13.478	12.939	1.783	1.402	G1
52898.305	0.417	12.522	13.426	12.967	1.819	1.393	G1
52901.341	0.420	12.57	13.467	12.989	1.847	1.451	G1
52906.278	0.425		13.531	13.050	1.889	1.518	G1
52914.272	0.433	12.59	13.548	13.085	1.940	1.507	G1
52917.291	0.437	12.566	13.544	13.087	1.944	1.581	G1:
52919.358	0.439	12.657	13.580	13.129	1.960	1.542	G1
52925.400	0.445	12.655	13.600	13.135	1.971	1.568	G1
52927.285	0.447	12.645	13.637	13.128	1.953	1.416	G1
52931.274	0.451	12.649	13.669	13.122	1.970	1.399	G1
52937.383	0.458	12.696	13.687	13.126	1.958	1.368	G1
52949.247	0.470	12.709	13.652	13.136	1.977	1.366	G1
52952.250	0.473	12.707	13.653	13.138	1.969	1.354	G1
52954.251	0.475	12.723	13.651	13.130	1.976	1.349	G1
52957.208	0.478	12.703	13.660	13.130	1.954	1.338	G1
52963.296	0.485	12.768	13.732	13.178	1.987	1.341	G1
52964.271	0.486	12.731	13.658	13.107	1.940	1.283	G1
52965.229	0.487	12.720	13.649	13.093	1.93	1.29	G1
52971.290	0.493	12.753	13.700	13.151	1.977	1.335	G1
52977.255	0.499	12.770	13.701	13.172	1.977	1.362	G1
52981.268	0.504	12.800	13.75	13.201	2.016	1.375	G1
52982.343	0.505	12.790	13.74	13.199	2.027	1.401	G1
52992.174	0.515	12.801	13.735	13.227	2.031	1.447	G1
53000.239	0.523		13.801	13.259		1.464	G1
53011.260	0.535		13.86	13.306	2.086		G1:
53013.272	0.537	12.930	13.82	13.232	2.122	1.483	G1
53016.229	0.540	12.850	13.82	13.239	2.068	1.440	G1
53056.681	0.582	12.782	13.710	13.158	2.039	1.439	G1
53070.671	0.597		13.683	13.165	2.015	1.398	G1

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CHANGES IN THE PERIOD AND LIGHT CURVE OF W CORVI

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The close eclipsing binary star W Corvi (EB or Beta Lyrae type; BD-12 3563, GSC5525-00352) became famous as a candidate for the 'broken-contact' phase of the Thermal Relaxation Oscillation (TRO) theory for how contact binary stars come into and maintain contact. Its light curve shows substantially different eclipse depths, indicating the two stars have significantly different temperatures, yet the short period of just 9.33 hours implies a contact configuration. Yang and Liu (2002) list about a dozen systems that exhibit this behavior, but W Corvi is the coolest case (spectral type G2), where the stars are both convective near the surface, which should wipe out any temperature difference.

Odell (1996) fit a linear ephemeris to 17 minima between 1935 and 1993 after finding no strong evidence for a period change. That paper also analyzed light curves from 1981 and 1988 using the Wilson-Devinney (Wilson, 1998) code including starspots, and concluded that photometry alone leaves three ambiguities: the mass ratio, the temperature distribution on the secondary star (concomitant with an ambiguity in degree of contact), and the cause and location of the "O'Connell" effect (fainter at phase 0.75 than 0.25). Rucinski and Lu (2000) obtained spectra of W Crv, and determined a mass ratio of 0.682 ± 0.016, thus removing the first ambiguity, while the second and third still stand.

Rucinski and Lu (2000) suggest, based on their 1997 radial velocity curve, that the period of W Crv is increasing slowly. They also conclude that variations of the light curve at all phases except primary eclipse indicate that mass exchange and accretion processes are operating between the stars, rather than cool dark spots. One purpose of this paper is to confirm the quadratic ephemeris. The other purpose is to point out that between 1999 and 2003 there has again been a large (10%) change in the light curve in that the two maxima are again equal in brightness (the O'Connell effect has again disappeared), and that the seasonal variation of the phase 0.25 maximum may be due to the comparison star "c" being slightly variable on a long timescale by 0.02 or 0.03 magnitudes.

The first timing of a minimum of W Crv was made by Lange in 1935, reported in Tsesevich (1954) as Min I HJD 2427861.361, apparently based on photographic discovery plates. Tsesevich also published visual (Nikolai Samus, priv. comm.) measurements made in 1944 and 1945, including the original brightness estimates. The 1944 data are of prime concern here because Tsesevich makes the point that the time of Min II is at phase 0.57, indicating an eccentric orbit. In fact, that timing yields a large residual for any reasonable ephemeris, so we re-analyzed that year's data in light of the current best period, and no such shift of secondary minimum could be found. Thus, for 1944, we used two newly-determined timings of Min I at HJD 2431180.2328 and Min II HJD 2431180.4299, different by +0.0018 days and −0.0201 days respectively. The 1945 timings were used as published, Min I HJD 2431562.106 and Min II HJD 1431562.305. Soloviev (1947) reported timings based on 84 visual measurements of Min I HJD 2432309.548 and Min II HJD 2432309.742; there was no evidence of an offset in the secondary minimum.

Dycus (1968) published the first photoelectric light curve, but his work was hampered by the small size of his telescope and the star being low in the western sky. We have re-analyzed his data to determine a timing of Min II at HJD 2439648.7357.

G. Samolyk (priv. comm.) kindly provided a total of 108 visual and 6 CCD timings made from 1971 to 2002 by members of the American Association of Variable Star Observers (AAVSO). These are available at `www.aavso.org/committees/eb/ebmono.stm` on the web and from the references to Baldwin (1976, 1977, and 1978) and Baldwin and Samolyk (1993, 1997, and 2002). The visual measurements made during each season were averaged by shifting each minimum by the well-known period and averaging to get one time for the season. In three cases, where only one or two measures were made and the residual from the ephemeris was more than ten minutes, the season was eliminated (1980, 1983, and 1989).

We used the 31" Cassegrain telescope at Lowell Observatory with the NURO CCD (LN2 cooled, 512 × 512 pixels) in 1999, and with Marc Buie's Photometrics CCD (thermoelectric cooling, TH7883 chip, 384 × 576 pixels) in 2001, 2002, and 2003 to obtain light curves. In 2003, one additional timing was made with University of Tasmania's Mt. Canopus 1-m telescope and the PLANET program CCD camera. All of these timings are listed here in Table I.

Most of the images we used included on chip both the comparison star "c" (=GSC05525-00217), located 4^s west and $160''$ south of W Crv, and check star "d" (=GSC05525-00351), located 16^s east of W Crv and $55''$ south (Fig. 1). A finding chart is given also in Tsesevich (1954), and the 1855 coordinates are given in Dycus (1968). Star "c" seems to be variable by a few hundredth of a magnitude on long timescale, but appears to be constant during any one night. The photoelectric data are too inhomogeneous to correct for this effect, so absolute levels of early light curves should be used with caution. For instance, we believe this is the cause of Rucinski and Lu's (2000) finding a variation of W Crv around phase 0.25.

Table I. Times of Minimum of W Corvi, 1999-2003

HJD (2450000.+)	Type	Filters	HJD (2450000.+)	Type	Filters
1305.7230	Primary	*VRI*	2325.7983	Secondary	*BVRI*
1306.6938	Secondary	*VRI*	2325.9901	Primary	*BVRI*
1307.6639	Primary	*VRI*	2701.8486	Secondary	*BVRI*
2028.7212	Primary	*BVRI*	2704.1768	Secondary	*VI*
2029.6929	Secondary	*BVRI*	2704.7598	Primary	*BVRI*
2030.6619	Primary	*BVRI*	2704.9538	Secondary	*BVRI*
2320.9456	Primary	*BVRI*	2705.9240	Primary	*BVRI*

The complete list of timings used for the ephemeris and the residuals shown in Fig. 1 are available from the IBVS web site as 5514-t1.txt.

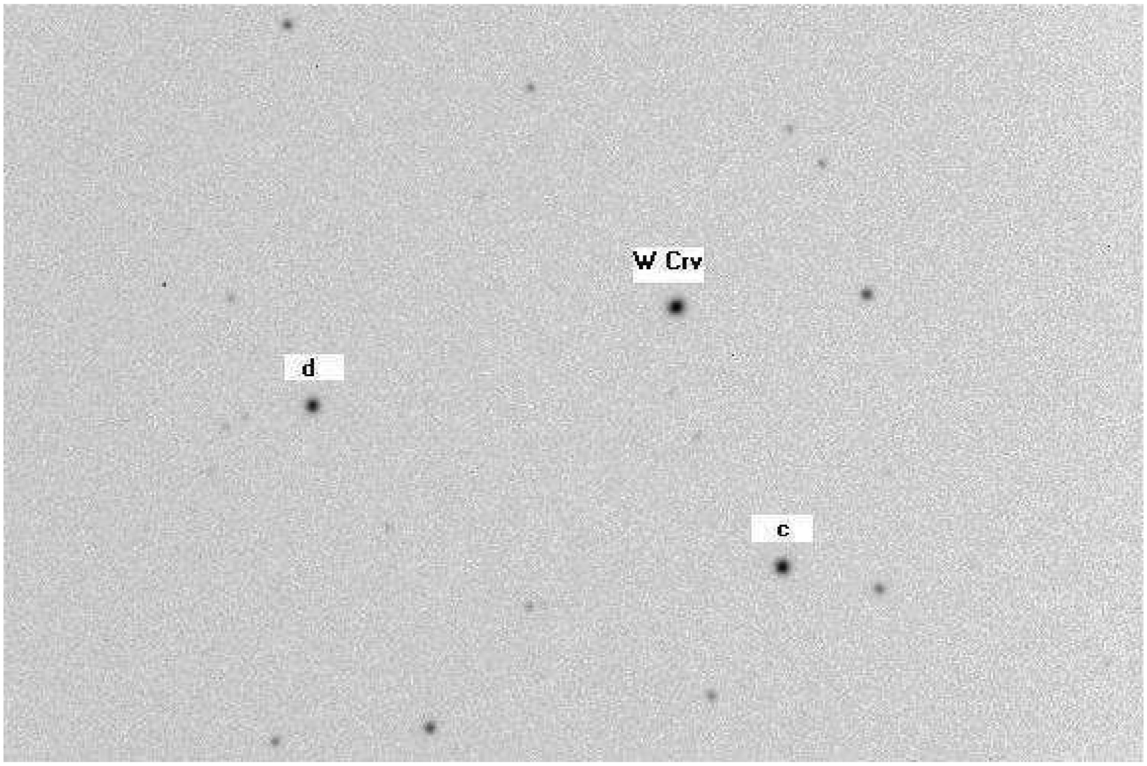

Figure 1. Finding chart

In order to test the increasing-period hypothesis, we used all timings starting in 1967 to derive a linear ephemeris, yielding a period of 0.38808134 days. We then looked at the residuals for evidence of curvature, and fitted a quadratic ephemeris. Fig. 2 shows the residuals from the linear fit, along with the quadratic residuals. The timings from the 1940's are clearly better fit by the quadratic, and the curvature in the later timings is noticeable. This confirms the suggestion of Rucinski and Lu (2000) that W Crv is increasing its period by about 0.25 sec/century. This corresponds to a value of $(d \ln P/dt)$ in the range of $7.5x10^{-8}$ year^{-1}.

Though the data described above were originally obtained in order to improve the ephemeris, another important property of the system has emerged. From its earliest extant light curves in the 1940's, W Crv has shown a classic O'Connell effect, in that the sides of the stars visible after secondary eclipse are about 0.1 mag fainter than the other side. Between 1966 and 1981, the star was not observed, but Odell (1996) showed that in 1981 and 1982, the two maxima were of equal brightness. By 1988, the difference in brightness had returned (see Fig. 3, light curves from 1988 and 1993).

In 1999, the light curve looked very similar to 1993, but Fig. 4 shows that by 2001, the brightness at phase 0.70 had increased by about 0.05 mags. This CCD photometry is of considerably higher quality compared to the earlier photoelectric light curves. No other differences in the light curves are noticeable – the only change is in the phase interval 0.60 to 0.80.

Fig. 5 shows light curves from 2002 and 2003, where the two maxima are of the same brightness.

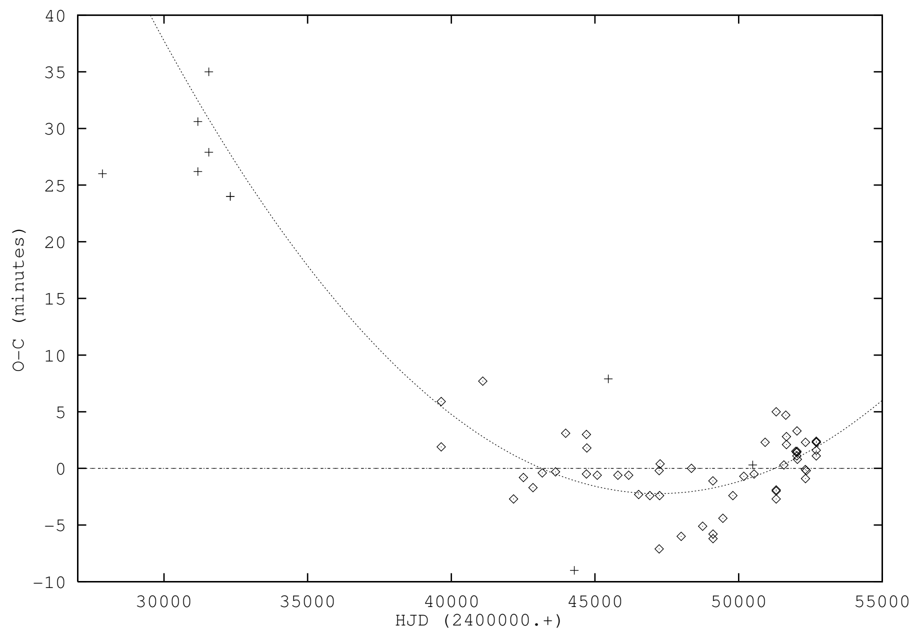

Figure 2. Residuals from linear ephemeris

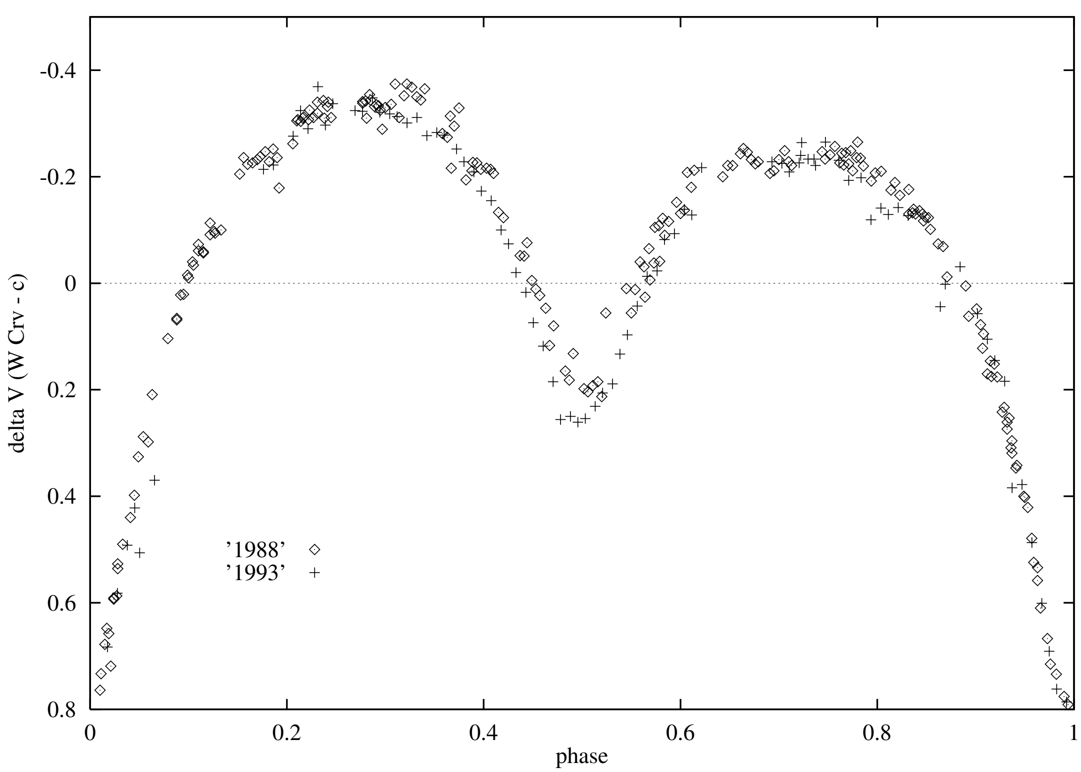

Figure 3. V light curves from 1988 and 1993.

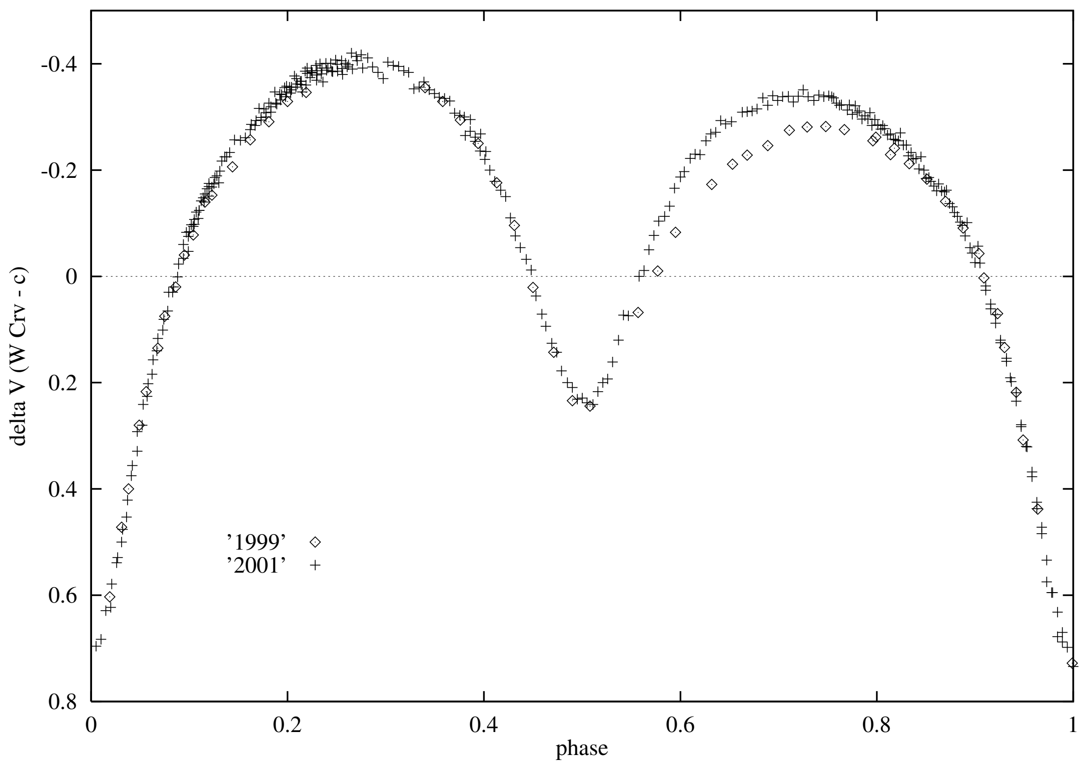

Figure 4. V light curves from 1999 and 2001.

Light levels for the four phases of quadrature are estimated in Table II - the reader is cautioned against attaching too much significance to any one value, as it seems the comparison star "c" may well be variable from night to night by several hundredth of a magnitude. But the difference between phase 0.25 and 0.75 (last column) between 1988-2001 is much larger than the variation of the comparison star, and hence is real.

Table II. Magnitude differences $(WCrv - c)$ at various phases

Year	$\Phi = 0.00$	$\Phi = 0.25$	$\Phi = 0.50$	$\Phi = 0.75$	delta $(0.75 - 0.25)$
1988	0.79	-0.35	0.21	-0.24	0.11
1993	0.79	-0.32	0.27	-0.24	0.09
1999	0.73:	-0.38:	0.25	-0.28	0.10:
2001	0.74	-0.40	0.24	-0.34	0.07
2002	0.73	-0.36:	0.22	-0.32	0.04:
2003	0.78	-0.34	0.20	-0.34	0.00

Values marked with : are estimates due to sparse data.

We conclude that W Crv indeed does show a secular period increase, but that variations of the light curve at any but the second maximum (around phase 0.75) may well come from variation of the comparison star. We point out that from 1999 to 2003, the feature which causes the O'Connell effect has again disappeared. It is of utmost interest to continue to observe this star for period change, and even to search archival plates to see if earlier times of minimum light can be found. Complete light curves are important in the next few years in order to see how long the O'Connell effect will be missing, and the timescale for its eventual return.

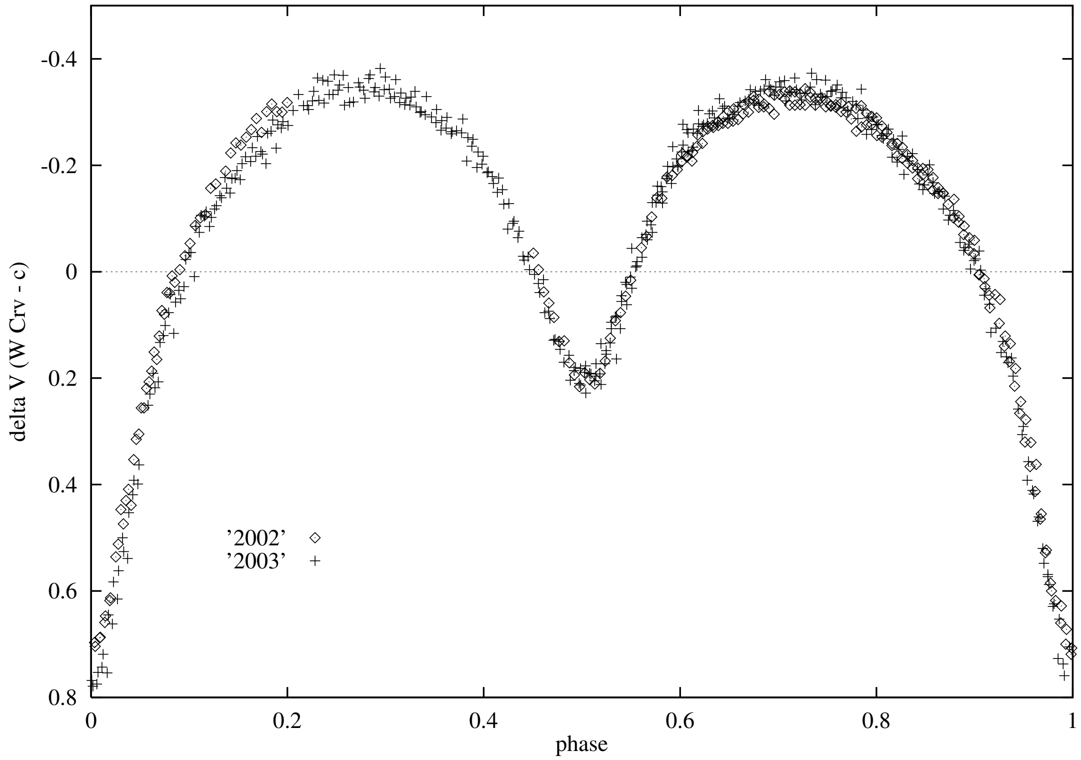

Figure 5. V light curves from 2002 and 2003.

We acknowledge with thanks the variable star observations from the AAVSO International Database contributed by observers worldwide and used in this research. This research made use of the SIMBAD data base, operated at CDS, Strasbourg, France. We thank Marc Buie for including W Crv in his automated CCD photometry program and supplying some of the data used here. We also thank S. Rucinski, Katalin Olah, and an anonymous referee, for valuable comments on the manuscript.

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CCD PHOTOMETRY OF THE VARIABLE STARS V882 Her, V386 Vul AND LX Peg

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Observed star(s):				
Star name	GCVS type	Coordinates (J2000) RA	Dec	Comp./check star(s)
V882 Her	RRc	$17^h44^m49\overset{s}{.}1$	$+28^\circ01'00''$	CTI catalog
V386 Vul	RRc	$21^h21^m42\overset{s}{.}8$	$+28^\circ09'06''$	CTI catalog
LX Peg	EW	$22^h03^m18\overset{s}{.}9$	$+28^\circ02'42''$	CTI catalog

Observatory and telescope:
CCD Transit Instrument (CTI), 1.8-m f/2.2 meridian pointing telescope
Capilla Peak Observatory (CAP), 0.61-m f/15.2 Cassegrain telescope
US Air Force Academy Observatory (AFA), 0.61-m f/15.6 Cassegrain telescope

Detector:	CTI: RCA LN2-cooled CCD, 320×512 pixels, $8.3'$ wide strip, CAP: RCA LN2-cooled CCD, 320×512 pixels, $3.6' \times 5.2'$ FOV, AFA: Photometrics LN2-cooled CCD, 512×512 pixels, $3.6' \times 3.6'$ FOV.
Filter(s):	CTI: BVR, CAP: V, AFA: BV

Date(s) of the observation(s):
CTI: 1988.04–1991.05, CAP: 1994.06–1995.11, AFA: 1998.06–2003.09

Photometric characteristics for these stars are listed in Table 1: $V_{\rm Max}$ and $V_{\rm Min}$ are the average standard V magnitudes at maximum and minimum light (CAP and AFA magnitudes transformed to CTI instrumental magnitudes via differential photometry with nearby stars in CTI database and then to standard magnitudes as detailed in Wetterer et al. 1996 - hereafter W96); $V_{\rm Mean}$ is the flux averaged standard V magnitude; $(B-V)$ is the B-V color (recalculated from CTI data for V882 Her (at minimum light) and V386 Vul (at maximum light due to limited CTI B observations), and average value and recalculated with CTI and AFA data for LX Peg); $E(B-V)$ is reddening (from W96 as estimated from Burstein and Heiles 1982); period is in days, epoch is HJD of maxima for V882 Her and V386 Vul and HJD of primary minima for LX Peg.

Table 1: Photometric characteristics

	V882 Her	V386 Vul	LX Peg
$V_{\rm Max}$	15.507(8)	15.155(7)	13.868(3)
$V_{\rm Min}$	15.828(10)	15.598(13)	14.060(5) (primary)
			14.032(9) (secondary)
$V_{\rm Mean}$	15.659(3)	15.359(3)	13.945(1)
$(B-V)$	0.31(4)	0.176(15)	0.978(5)
$E(B-V)$	0.056	0.152	0.090
period	0.377501(8)	0.2452165(7)	0.279152(2)
epoch	2452833.786(9)	2451092.790(4)	2452589.6290(24)
type	RRc	RRc	EW

Notes on individual stars:

V882 Her was listed in W96 as a RR Lyrae type c variable star with a period of 0.377069 days, although it was noted that the 1990-1991 CTI data did not match well with the chosen period. The additional AFA V observations make it clear that V882 Her's period is changing. Unfortunately, due to the large gaps of time between the various sets of data and the fact that CTI makes only one observation per night, creating a standard O-C plot for this star is impossible due to cycle count ambiguities. Instead, we used Lafler and Kinman's method for determining periods (Lafler and Kinman 1965) on subsets of the data to determine acceptable periods and their errors. Figure 1 plots the best periods and periods for aliases that produce reasonable but inferior light curves as a function of central year for various subsets of the data (the x-axis error bar indicates the range of data used). No acceptable periods could be found using the ranges 1988 to $\geq$ 1990, $\leq$ 1991 to $\geq$ 1998, and $\leq$ 1994 to 2003. The simplest solution to building a composite lightcurve is to use three different periods covering 1988-1989, 1990-1994, and 1998-2003. Figure 2 plots V882 Her's lightcurve for these three periods and the composite lightcurve using each period over the applicable time. Accepting these best periods leads to an anomalously large average period change rate of $\beta = 37 \pm 8$ days/Myr (shown as a line in Figure 1). More observations are clearly needed over a longer time baseline to better quantify the period change.

V386 Vul was listed in W96 as a RR Lyrae type c variable star with a period of 0.325160 days, although because of the sidereal day aliasing of CTI observations, it was noted that other periods were possible. Combining the CTI and AFA V observations (there were no CAP observations) indicate that V386 Vul's period is indeed a sidereal day alias to the originally calculated period. The new period is 0.2452165 days and the lightcurve is plotted in Figure 3.

LX Peg was listed in W96 as a W UMa type eclipsing variable with a period of 0.279144 days, although it was noted that some data did not fit this period very well and several other short periods were equally possible. Additional CAP and AFA V observations confirm that the period is close to the originally published period, however, this additional data also indicates that LX Peg's period may be changing. Employing a similar strategy as with V882 Her yields: no acceptable periods using all the data, 0.279152 $\pm$ 0.000002 days using AFA V data, and 0.279142 $\pm$ 0.000002 days using CTI and CAP V data. As in W96, the CTI and CAP period solution is marginal with some data not fitting well. Further subdividing of the data, however, is not practical. Figure 4 plots LX Peg's lightcurve for these two periods and a composite lightcurve using each period with the applicable data. More observations over a longer time baseline are needed to better quantify the possible period change. New AFA B observations were made to check the B-V color and the B amplitude of variation. This was done to confirm LX Peg is too red to be a pulsational variable of the δ Sct type. A few of the AFA nights included enough phase coverage to measure minima timings for LX Peg using the Kwee and Van Woerden method (Kwee and Van Woerden 1956). These timings are listed in Table 2.

Table 2: LX Peg minima timings

HJD	type
2451041.874(6)	secondary
2451048.709(6)	primary
2451048.850(5)	secondary
2451082.771(13)	primary
2451092.739(8)	secondary
2452589.6290(24)	primary

Acknowledgements:

The authors wish to thank Robert Kunkle for additional Capilla Peak observations, and Erik Carlson and Ray Bloomer for helping with the USAFA observations.

References:

Burstein, D., and Heiles, C., 1982, *AJ*, 87, 1165.
Kwee, K. and Van Woerden, H., 1956, *BAN*, 12, 327.
Lafler, J. and Kinman, T. 1965, *ApJ Sup.*, 11, 216.
Wetterer, C.J., McGraw, J.T., Hess T.R., and Grashuis, R., 1996, *AJ*, 112, 742.

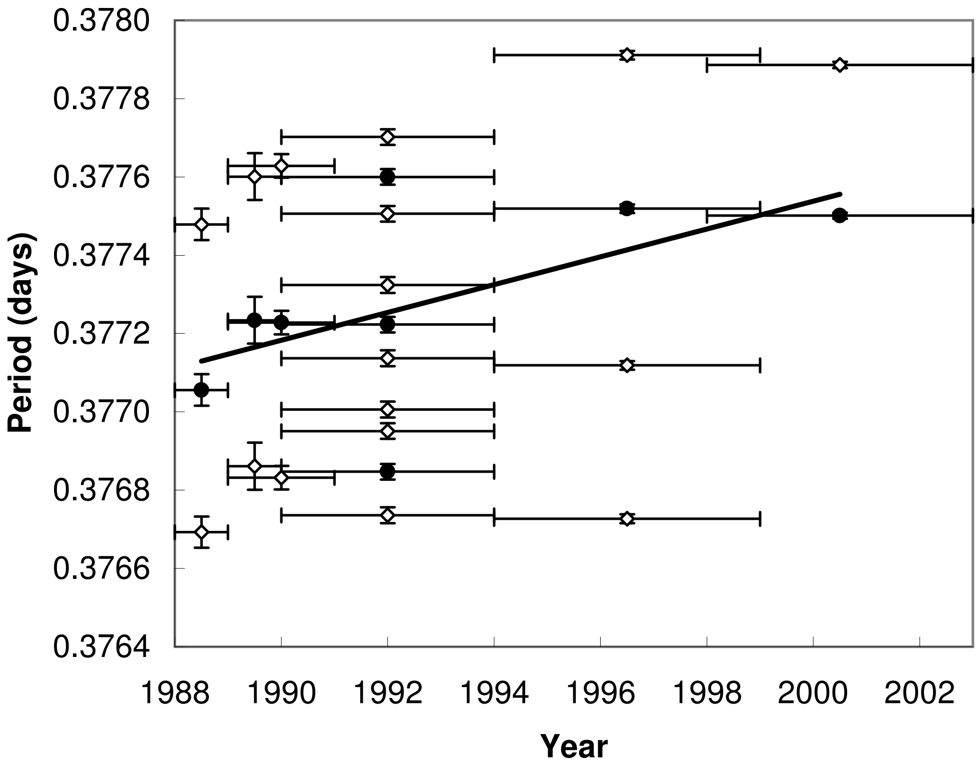

Figure 1. Calculated periods for V882 Her in days as a function of year. Filled diamonds are best periods, open diamonds are aliased periods that produce inferior light curves.

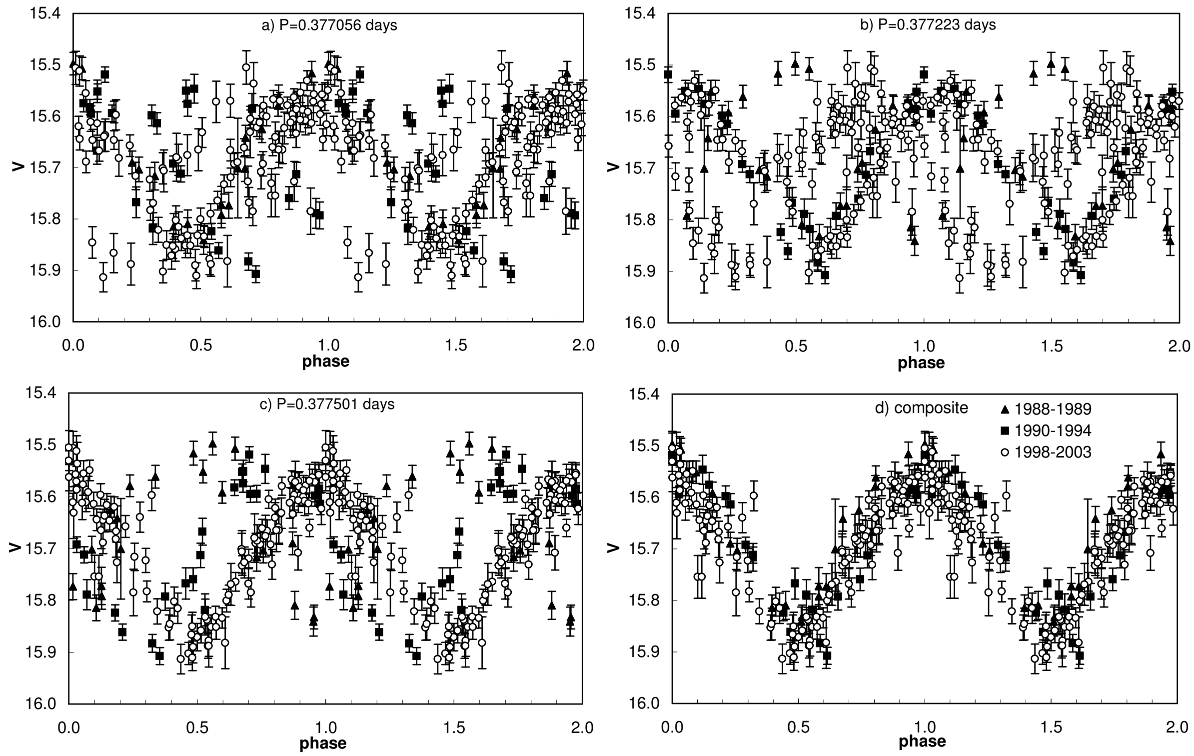

Figure 2. Light curves for V882 Her using various periods. Composite light curve uses - 1988-1989: P = 0.377056 days, epoch = 2447319.8405 HJD; 1990-1994: P = 0.377223 days, epoch = 2449552.8130 HJD; 1998-2003: P = 0.377501 days, epoch = 2452833.7863 HJD

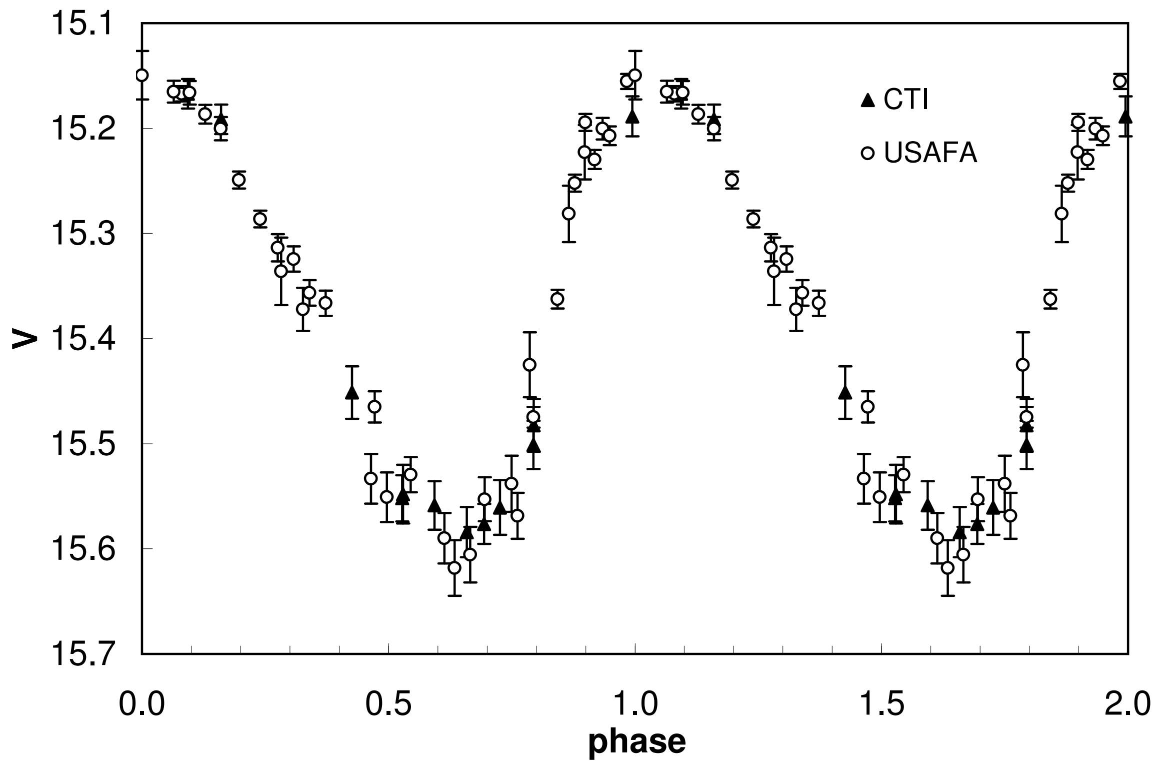

Figure 3. Ligh tcurve for V386 Vul: P = 0.2452165 days, epoch = 2451092.790 HJD

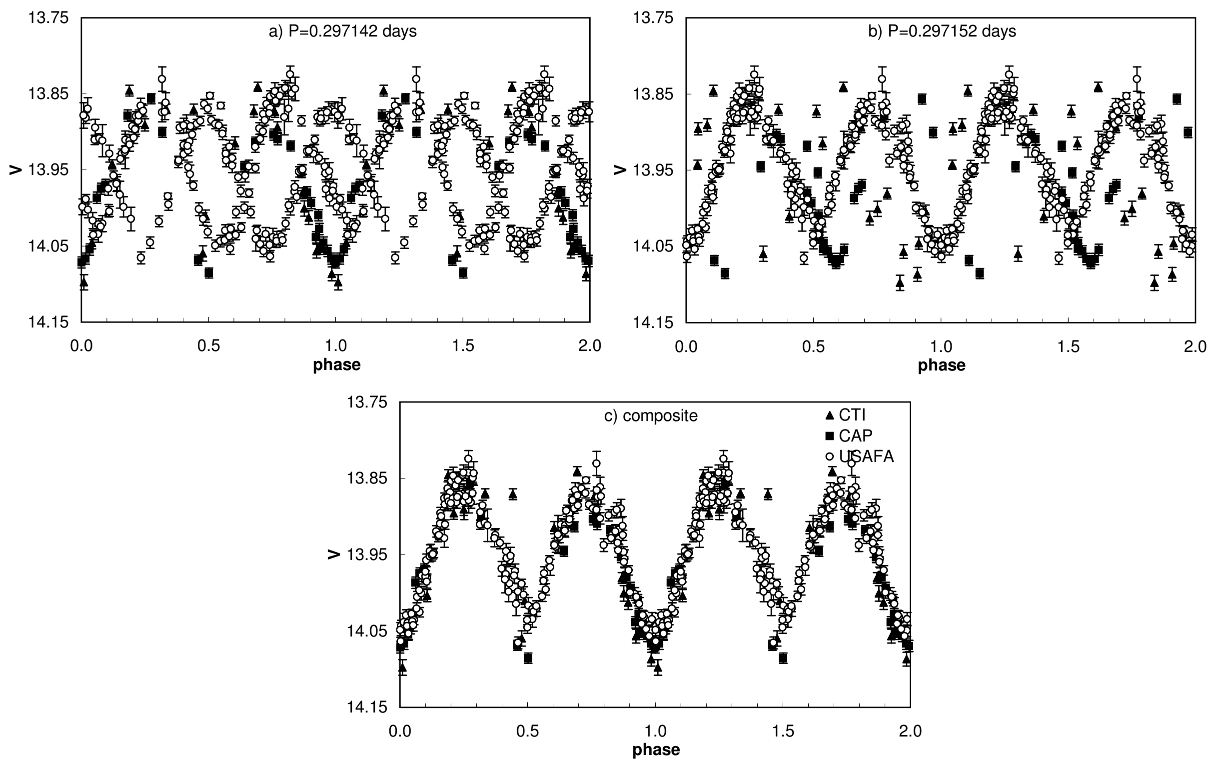

Figure 4. Light curves for LX Peg using various periods. Composite light curve uses - CTI/CAP: P = 0.279142 days, epoch = 2450036.670 HJD; AFA: P = 0.279152 days, epoch = 2452589.630 HJD

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CCD LIGHT CURVES OF ROTSE1 VARIABLES, XX: GSC 3510:1283 Her, GSC 2618:1385 Her, GSC 2614:1369 Her, AND GSC 2615:1821 Her

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Observatory and telescope:
Private observatory Schüsselacher, Wald, 0.15-m Starfire refractor

Detector:	SBIG ST-7 CCD camera

Method of data reduction:
Standard CCD-frame reduction using AIP4WIN software

Method of minimum determination:
Kwee – van Woerden algorithm

Observed star(s):				
Star name	GCVS type	Coordinates (J2000) RA	Dec	Comp./check star(s)
GSC 3510:1283				
ROTSE1 J173834.17+452718.4	EW	17 38 34.2	+45 27 18	GSC 3510:1129 / GSC 3510:1583
GSC 2618:1385				
ROTSE1 J173925.40+364700.9	EW	17 39 25.4	+36 47 01	GSC 2618:1243 / GSC 2618:1191
GSC 2614:1369				
ROTSE1 J174143.73+341208.9	EW	17 41 43.7	+34 12 09	GSC 2615:2024 / GSC 2614:1215
GSC 2615:1821				
ROTSE1 J174357.38+341802.5	EW	17 43 57.4	+34 18 02	GSC 2615:1861 / GSC 2615:2174

Ephemeris:			
Star name	E 2400000+	P [day]	Source
ROTSE1 J173834.17+452718.4	52871.3786(4)	0.2783504	present paper
ROTSE1 J173925.40+364700.9	52898.3476(2)	0.337146	”
ROTSE1 J174143.73+341208.9	52898.3144(5)	0.334711	”
ROTSE1 J174357.38+341802.5	52907.3998(4)	0.340092	”

Times of minima:

Star name	Time of min. HJD 2400000+	Error	Type	Filter	$O-C$ [day]	Rem.
GSC3510:1283 (Her)	51308.7214	8	p	none		ROTSE1
	51308.8562	7	s	none		ROTSE1
	52871.3771	9	p	none		
	52871.5177	18	s	none		
	52875.4151	12	s	none		
	52886.4074	13	p	none		
	52898.3778	13	p	none		
	52898.5178	13	s	none		
	52899.3533	13	s	none		
	52907.2856	18	p	none		
	52907.4259	21	s	none		
	52924.4056	8	s	none		
	52926.353	4	s	none		
	52928.3021	11	s	none		
GSC2618:1385 (Her)	51308.8752	8	s	none		ROTSE1
	51311.7411	9	p	none		ROTSE1
	52871.3752	7	p	none		
	52871.5447	11	s	none		
	52875.4215	7	p	none		
	52886.3799	5	s	none		
	52898.3467	11	p	none		
	52898.5173	9	s	none		
	52899.3591	4	p	none		
	52907.2826	24	s	none		
	52924.3074	16	p	none		
	52926.3303	19	p	none		
	52928.3537	3	p	none		
GSC2614:1369 (Her)	51297.895	3	s	none		ROTSE1
	52871.3707	5	s	none		
	52871.5390	4	p	none		
	52875.3868	7	s	none		
	52886.4318	7	s	none		
	52898.3170	16	p	none		
	52898.4811	8	s	none		
	52899.318	4	p	none		
	52907.3516	10	p	none		
	52924.424	4	p	none		
	52926.2598	11	s	none		
	52928.2711	11	s	none		
GSC2615:1821 (Her)	51286.865	4	p?	none		ROTSE1
	51305.7345	3	s?	none		ROTSE1
	52871.3500	22	p	none		
	52871.5209	3	s	none		
	52875.4319	6	p	none		
	52886.3144	8	p	none		
	52886.4839	11	s	none		
	52898.3874	5	s	none		
	52899.4069	12	s	none		
	52907.4008	15	p	none		
	52924.4035	12	p	none		
	52926.2737	13	s	none		
	52928.3156	24	s	none		

Explanation of the remarks in the table:
ROTSE1: Observations of Akerlof et al. (2000).

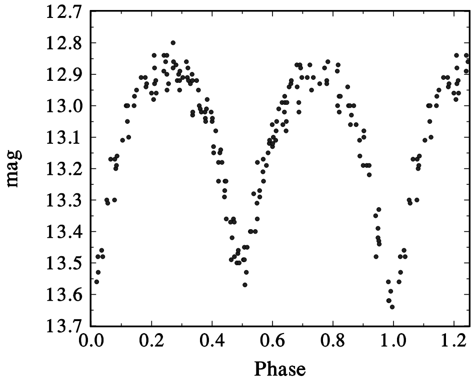

Figure 1. CCD light curve (without filter) of GSC 3510:1283

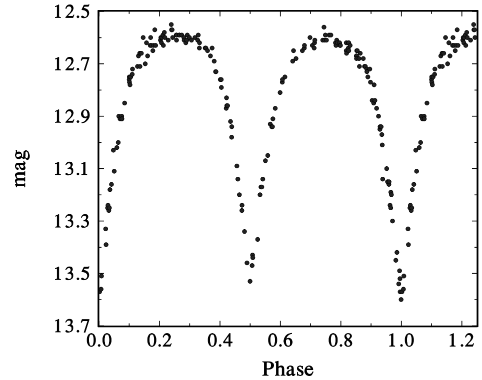

Figure 2. CCD light curve (without filter) of GSC 2618:1385

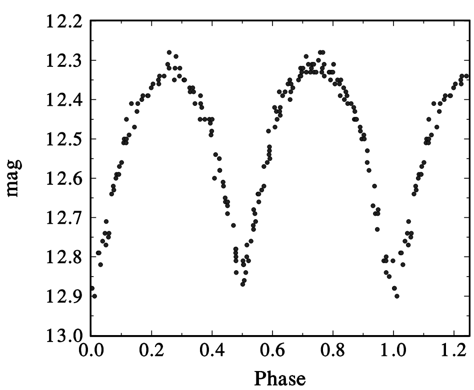

Figure 3. CCD light curve (without filter) of GSC 2614:1369

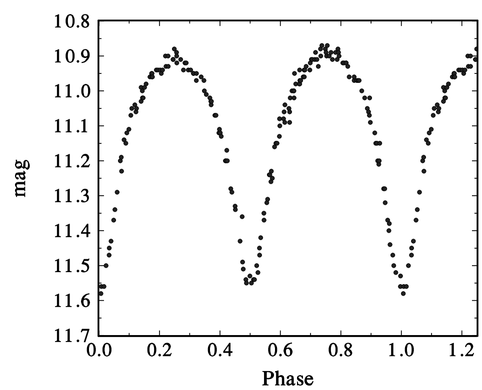

Figure 4. CCD light curve (without filter) of GSC 2615:1821

Remarks:
As a byproduct of the ROTSE1 CCD survey, a large number of newvariables have been discovered (Akerlof et al., 2000). In a series of papers, we report unfiltered CCD observations for some of the close binary systems (type EW) in the list of Akerlof et al. (2000). This installment contains information on four variables in the constellation Her. The four stars were observed with our CCD equipment during several nights between JD 2452871 and JD 2452928. A total of 185 CCD frames were measured of GSC 3510:1283, 198 frames of GSC 2618:1385, 193 frames of GSC 2614:1369 as well as 195 frames of GSC 2615:1821. Figures 1 through 4 show our observations folded with the elements given in the Table of Ephemeris. These elements of variation are deduced from a linear fit to the normal minima from the ROTSE1 data and the timings of minimum derived from our data given in the table of Times of minima.

Availability of the data:
Upon request from diethelm@astro.unibas.ch

Acknowledgements:
This research made use of the SIMBAD data base, operated at CDS, Strasbourg, France

Reference:

Akerlof, C., Amrose, S., Balsano, R., Bloch, J., Casperson, D., Fletcher, S., Gisler, G., Hills, J., Kehoe, R., Lee, B., Marshall, S., McKay, T., Pawl, A., Schaefer, J., Szymanski, J., Wren, J., 2000, *AJ*, **119**, 1901

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NSV 15852 IS LIKELY AN ELLIPTICAL VARIABLE AKIN IN TYPE TO AO Cas

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NSV 15852 = BD +56 864 = LS I +57 139 = GSC 03725-00498 was noted as being variable in the ultraviolet by the ANS catalogue of UV point sources (Wesselius et al., 1982). It seems in fact to be a member of the rare ELL/KE type, with a 1.175 ± 0.004 day period, and similar in nature to AO Cas, according to Northern Sky Variability Survey (NSVS) data (Wozniak et al., 2004).

The amplitude is about 0.3 instrumental magnitudes (NSVS Documentation suggests that ROTSE-I magnitudes are from a CCD chip with a spectral response similar to Johnson R that is filter cropped at the extrema of 450 and 1000 nm). Figure 1 shows the symmetry and cleanly sinusoidal nature of the light curve, as per the definition of elliptical variables, which compares favourably with that of AO Cas (see for example figure 1 of Hiltner, 1949) as opposed to the "concertina" like alternation in minima and maxima width that is displayed by an eclipsing star of type EW.

The spectral type of O6nn (Morgan, Code and Whitford, 1955) also compares directly to AO Cas in terms of the KE subtype. The spectral suffix 'nn' refers to the very nebulous appearance of the spectral lines within the spectrum, and considering that the orbital period is not particularly rapid, suggests that either atmospheric macroturbulence and/or gas stream action may be involved (note that 'nebulous appearance' in terms of spectral lines is in fact describing the morphological appearance of said lines, and in no way implies any nebulosity being involved with a star). In this case the object could be represented by a Roche lobe filling O6 star orbiting a smaller star of mass ratio 0.2.

However, Negueruela and Marco (2003) note from their observations that this O6nn type could merely be apparent, being a consequence of the dispersion used, and find it more likely that the lines are double and that the object could be a pair of O6V((f)) stars, in which instance they could be in a heavy over-contact configuration, and the light curve could then represent the combined ellipsoidal variability of both components (making the reasonable assumption of a fully synchronous system).

This latter possibility, given the paucity of known O type binaries suitable for mass and radius determination, would make the object of interest. It is presented in this light, as a candidate for further study, most likely of the radial velocity curve.

The 2MASS $J - K_s$ value of 0.05 is appropriate for a reddened star of this type, and this in tandem with the lack of any source in either the IRAS or MSX6C catalogues points towards there being no infrared excess as could be expected from any appreciable amount of circumstellar matter.

The NSV supplement (Kazarovets, Durlevich and Samus, 1998) quoted V magnitude of 9.68, when corrected for the $E(B-V)$ of 0.6 (Savage et al., 1985), gives a distance range of approximately 3.5 to 5.5 *kpc* dependent on whether the star is a dwarf or a giant (there is also uncertainty due to there being no evidence as to the companion's contribution to the total luminosity). This is appropriate if the star is part of Camelopardalis OB3 in the Cygnus or Outer Arm (Negueruela and Marco, 2003), as is likely also the case for the roughly adjacent HII nebulosity and star forming region S204.

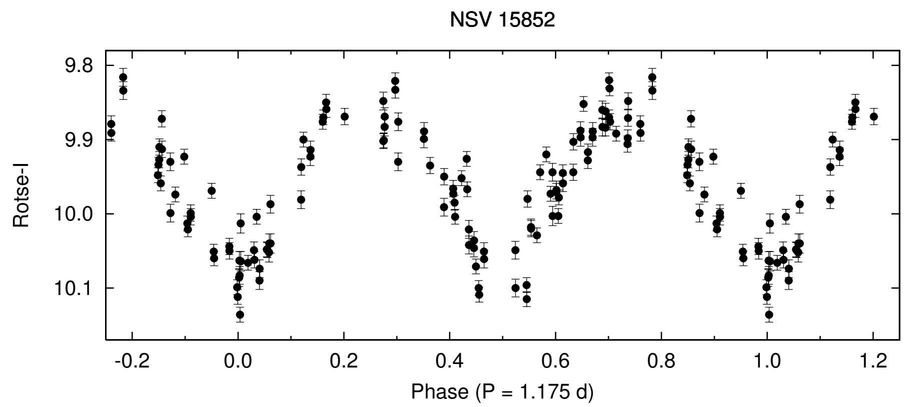

Figure 1. Phase diagram of NSVS ROTSE-I magnitude data for NSV 15852 folded on a 1.175 day period.

Acknowledgements: The referee is strongly acknowledged for important information and bringing an important literature point to our attention. The SIMBAD and VizieR services of the CDS, Strasbourg, where used in this research. 2MASS data is courtesy of IRAS/IPAC, a joint NASA and CalTech resource. This publication makes use of the data from the Northern Sky Variability Survey created jointly by the Los Alamos National Laboratory and University of Michigan. The NSVS was funded by the US Department of Energy, the National Aeronautics and Space Administration and the National Science Foundation (`http://skydot.lanl.gov/surveys.php`).

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Kazarovets, E.V., Durlevich, O.V., Samus, N.N, 1998, *IBVS*, No. 4655
Morgan, W.W., Code, A.D. and Whitford, A.E, 1955, *ApJS*, **2**, 41
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Savage, B.D., Massa, D., Meade, M., Wesselius, P.R., 1985, *ApJS*, **59**, 397
Wesselius P.R., van Duinen, R.J., de Jonge, A.R.W., Aalders, J.W.G., Luinge, W., Wildeman, K.J., 1982, *A&AS*, **49**, 427
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28 NEW VARIABLE STARS FROM SAVS

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28 new variable stars were discovered by the Semi-Automatic Variability Search sky survey (Niedzielski et al. 2003) operating at the Astronomical Observatory of the Nicolaus Copernicus University in Piwnice, near Toruń. Photometric data were collected with the semi-automatic CCD camera equipped with a 135/2.8 telephoto lens and SBIG ST-7 CCD camera with KAF 400 chip. Observations were gathered while monitoring 23 selected fields covering 138 square degrees of the northern hemisphere between September 2003 and January 2004. About 18,000 stars brighter than 13 mag were observed in near-Johnson V band. The list of observed fields, detailed hardware specification and description of data reducing software as well as original data are available on survey's web site `http://www.astri.uni.torun.pl/~gm/SAVS`.

For some of the new variables additional spectral observations were performed with the 0.9m Schmidt-Cassegrain telescope equipped with the Richardson spectrograph and a Wright CCD camera. Using the 600 gr/mm grating we obtained spectra between 3800 and 5800 Å with 2 Å/pix reciprocal dispersion. These spectra, after standard reduction performed with IRAF[1] were used for spectral classification.

A list of the new variable stars is presented in Table 1. The stars which variability type cannot be resolved with our photometric data (mostly long-term red irregular or semi-regular variables), were classified as "miscellaneous" and marked with MISC in Table 1. Light curves in near V filter of new variables are shown in Figures 1, 2 and 3. For regular periodic variables phased light curves are displayed. For long-term variables the data points were averaged over single nights and the standard deviation was taken as the near V magnitude error estimate. The original photometric data are available at the surveys web site.

The medium resolution spectra used for determination of spectral types of selected variables are presented in Figures 4 and 5 for early and late spectral types, respectively. Some characteristic spectral features used in classification are marked.

SAVS 225956+350948 (the infrared source IRAS 22575+3453) was observed as gradually fading object changing its brightness from about $m_V = 11$ mag at the beginning of monitoring. Near HJD 2452955 it became out of range of our instrument and was not detected in later CCD frames. It is possible that SAVS 225956+3509483 is a faint

[1] IRAF is distributed by the National Optical Astronomy Observatories, which are operated by the Association of Universities for Research in Astronomy, Inc., under cooperative agreement with the National Science Foundation.

variable of Mira type. The higher resolution spectrum of this star is shown in Figure 6. It was obtained with 1200 gr/mm grating covering spectral range between 5800 and 6800 Å (reciprocal dispersion of 1 Å/pix). Strong H_α emission line is clearly visible.

Table 1. List of new variables. *SAVS ID* – identifier consisted of Right Ascension and Declination of a star calculated for J2000.0, *Other ID* – cross-identification with other catalogs, m_V – observed maximal brightness in near-Johnson V band, Δm_V – amplitude of variation, N_{data} – number of collected data points (for long-term variables a number of observed nights are also given), T_0 – time of primary minimum for eclipsing binary systems or time of maximum for periodic pulsating variables (in Heliocentric Julian Days), P – period of variation in days, *Type* – type of variability in GCVS (Kholopov et al. 1998) convention.

SAVS ID	Other ID	m_V	Δm_V	N_{data}	$T_0 - 2450000$	P [days]	Type
004430+564550	GSC 3663-913	9.81	0.18	139/24	3033.2823	57.61(5)	SR
004534+561626	C27	11.29	0.45	141/24	...	...	MISC
004611+571305	GSC 3663-2412	10.81	0.32	124/22	...	...	MISC
012728+290618	GSC 1754-1133	10.79	0.33	200	2929.8486	0.491495(3)	EB
013237+615811	BD+61°285	9.35	0.10	176	2933.0564	0.67410(8)	BCEP
013333+613329	BD+60°265	8.51	0.21	180/31	3155.3509	92.6(6)	SR
022430+350810	GSC 2331-731	12.14	0.48	210	2931.3523	0.36907(2)	EB
022708+342319	GSC 2331-960	11.69	0.38	217	2939.1813	3.1078(2)	DCEP:
022841+342948	GSC 2331-1491	10.91	0.34	196/27	...	...	MISC
085324+564910	HD 237760	9.35	0.48	75/14	...	...	MISC
085744+524727	GSC 3805-1092	10.95	1.40	75/15	...	...	MISC
085759+524041	HD 233586	10.28	0.29	93/16	...	...	MISC
085819+522627	GSC 3423-745	10.73	0.97	95/16	3224.0235	101.7(1)	SR
213927+271556	BD+26°4227	9.81	0.20	178/44	...	...	MISC
223446+581804	GSC 3995-1441	9.97	0.31	287	2891.1763	1.955103(5)	EA
223949+583254	HD 240017	9.38	0.50	301	2894.2908	3.09209(3)	EA
224203+580404	GSC 3992-80	10.14	0.19	182/37	...	...	MISC
224621+595731	GSC 3996-312	11.28	0.27	279	2896.9093	3.0332(1)	DCEP
224712+595834	GSC 3996-574	12.13	0.34	308	2892.0818	0.425526(2)	EW
224823+602417	GSC 4265-193	12.09	0.64	299	2897.6785	4.27785(2)	DCEP
225956+350948	IRAS 22575+3453	11.03	1.83	126/18	...	...	M:
230131+304427	GSC 2750-854	10.66	0.40	274	2884.4259	0.471653(3)	EA/EB
230310+342508	GSC 2758-1820	12.40	0.58	132	2909.3356	0.318833(2)	RRAB
230623+340932	GSC 2759-1917	11.50	0.48	202/37	...	...	MISC
230915+341924	GSC 2759-1657	10.93	0.47	215/37	...	...	MISC
231034+314253	GSC 2751-1007	12.34	0.51	262	2885.2469	0.417461(3)	EW
232358+313933	GSC 2752-1159	11.49	0.63	239/39	3034.3841	50.11(3)	SRD
232629+312040	GSC 2765-348	12.04	0.62	277	2905.5446	0.28351(1)	EW

References:

Kholopov, P. N., Samus, N. N., Frolov, M. S., Goranskij, V. P., Gorynya, N. A., Karitskaya, E. A., Kazarovets, E. V., Kireeva, N. N., Kukarkina, N. P., Kurochkin, N. E., Medvedeva, G. I., Pastukhova, E. N., Perova, N. B., Rastorguev, A. S., Shugarov, S. Yu., 1998, *The Combined General Catalog of Variable Stars*, 4.1 Edition (available via the Internet: `http://cdsweb.u-strasbg.fr/cgi-bin/Cat?II/214A`)

Niedzielski, A., Maciejewski, G., Czart, K., 2003, *AcA*, **53**, 281

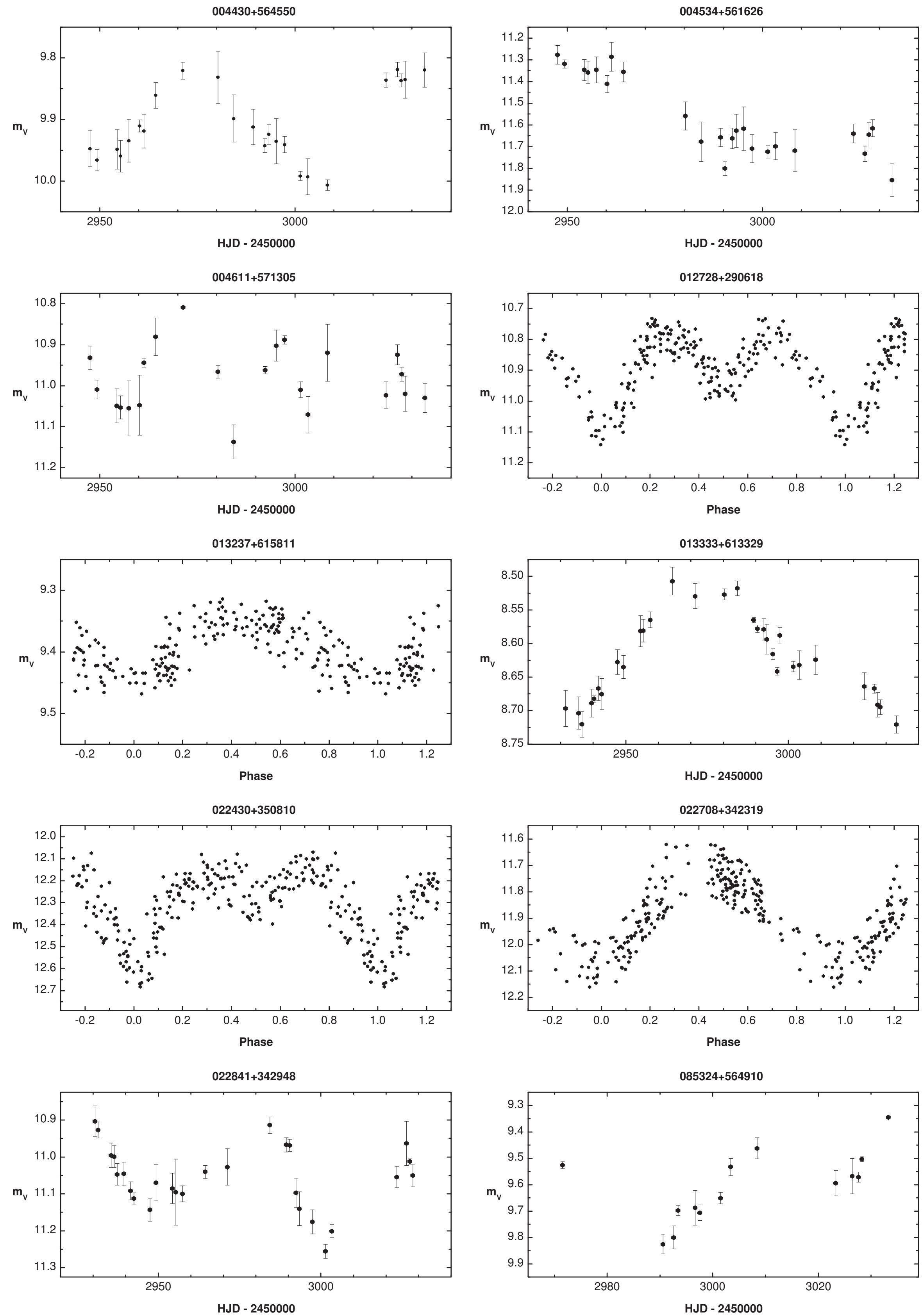

Figure 1. Light curves of new variables.

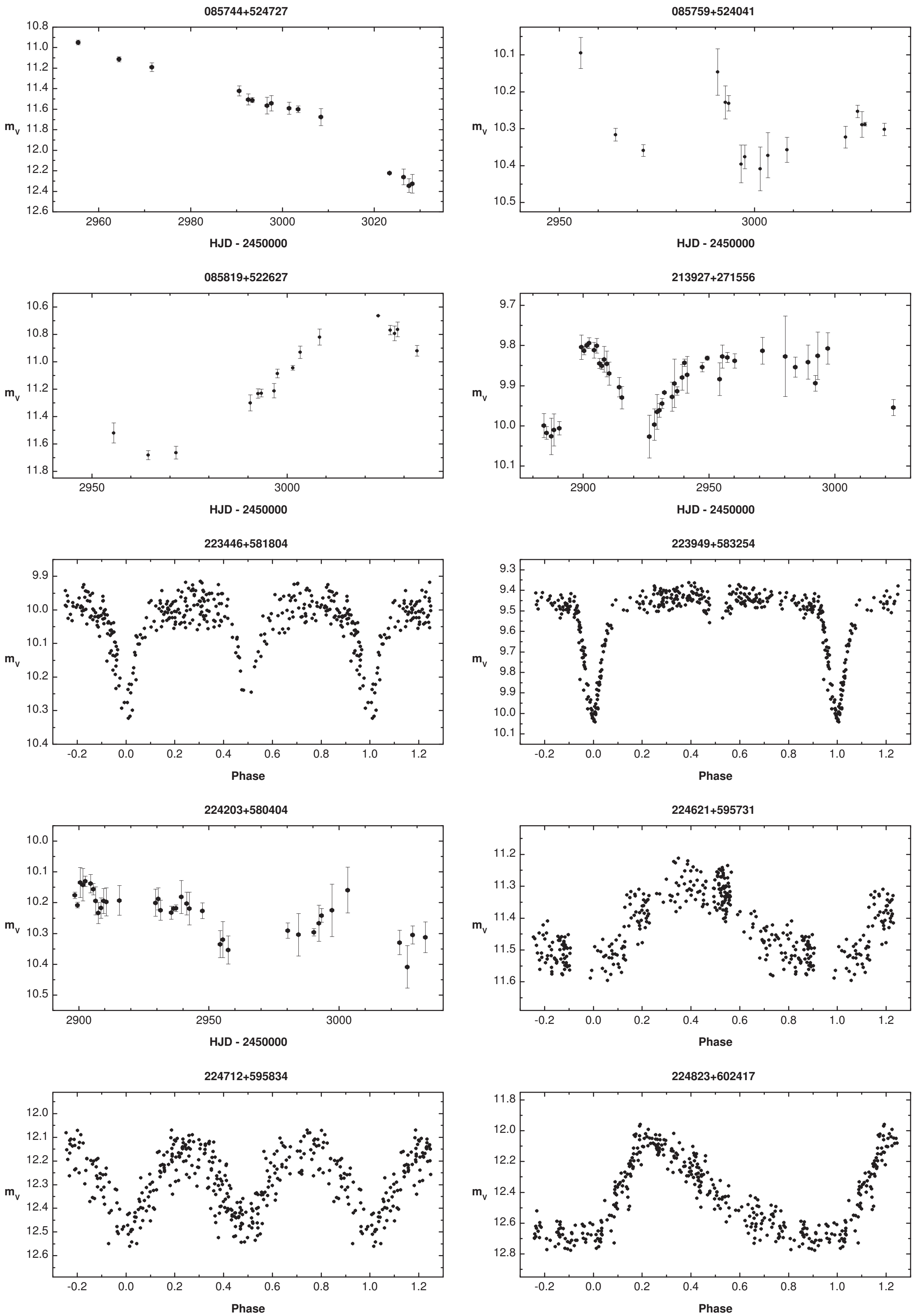

Figure 2. Light curves of new variables.

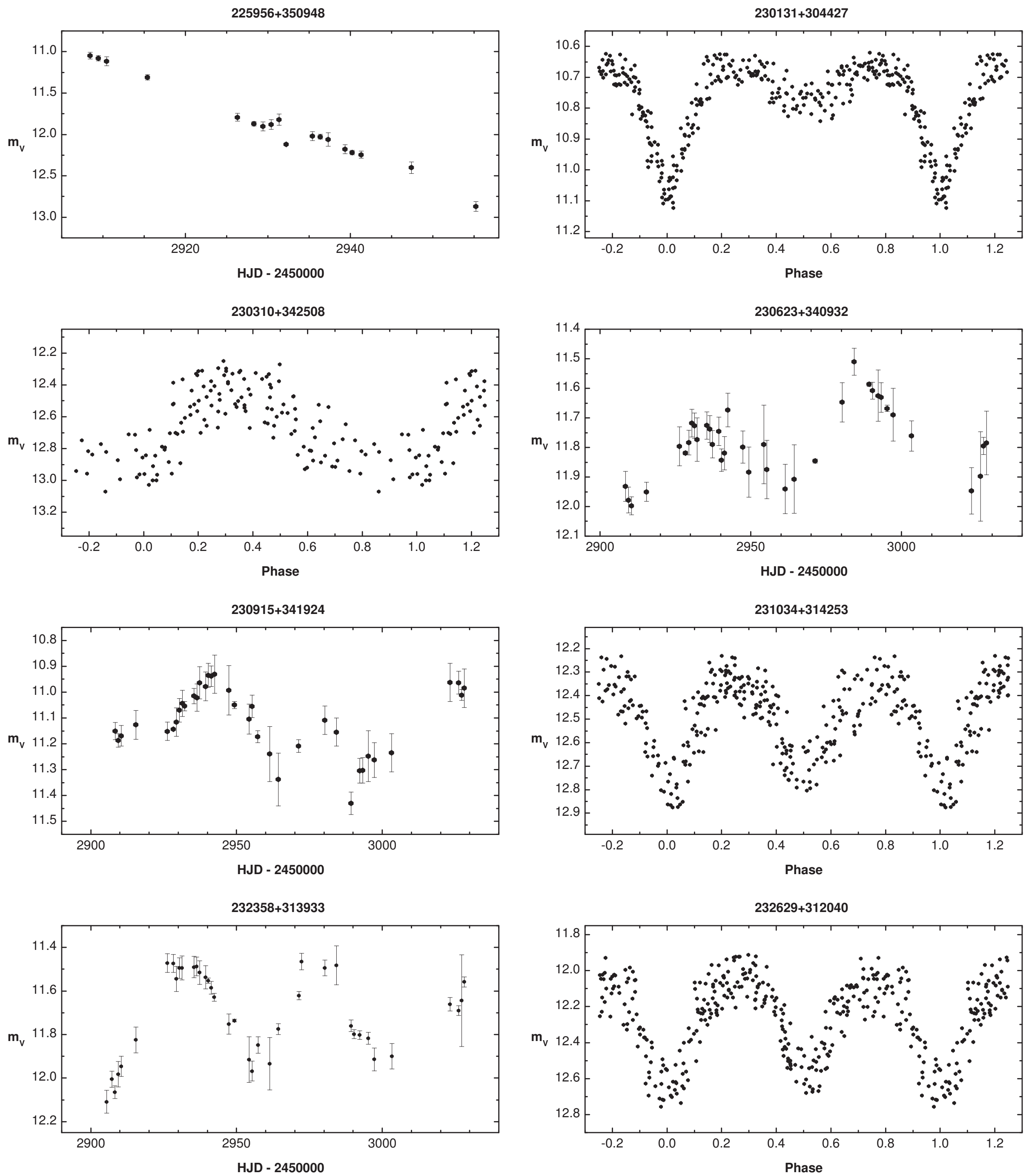

Figure 3. Light curves of new variables.

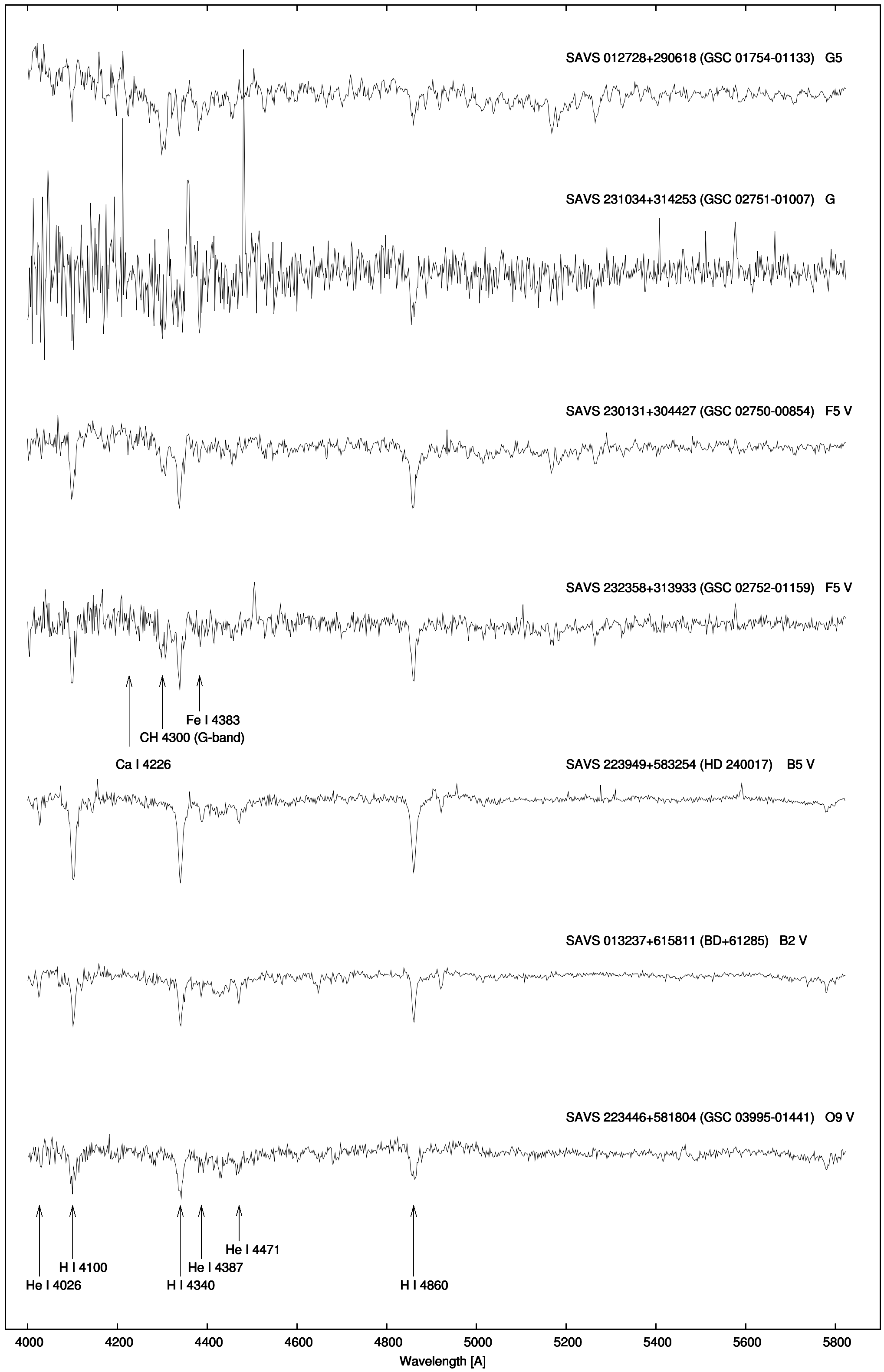

Figure 4. Spectra of several newly detected variables of early spectral type.

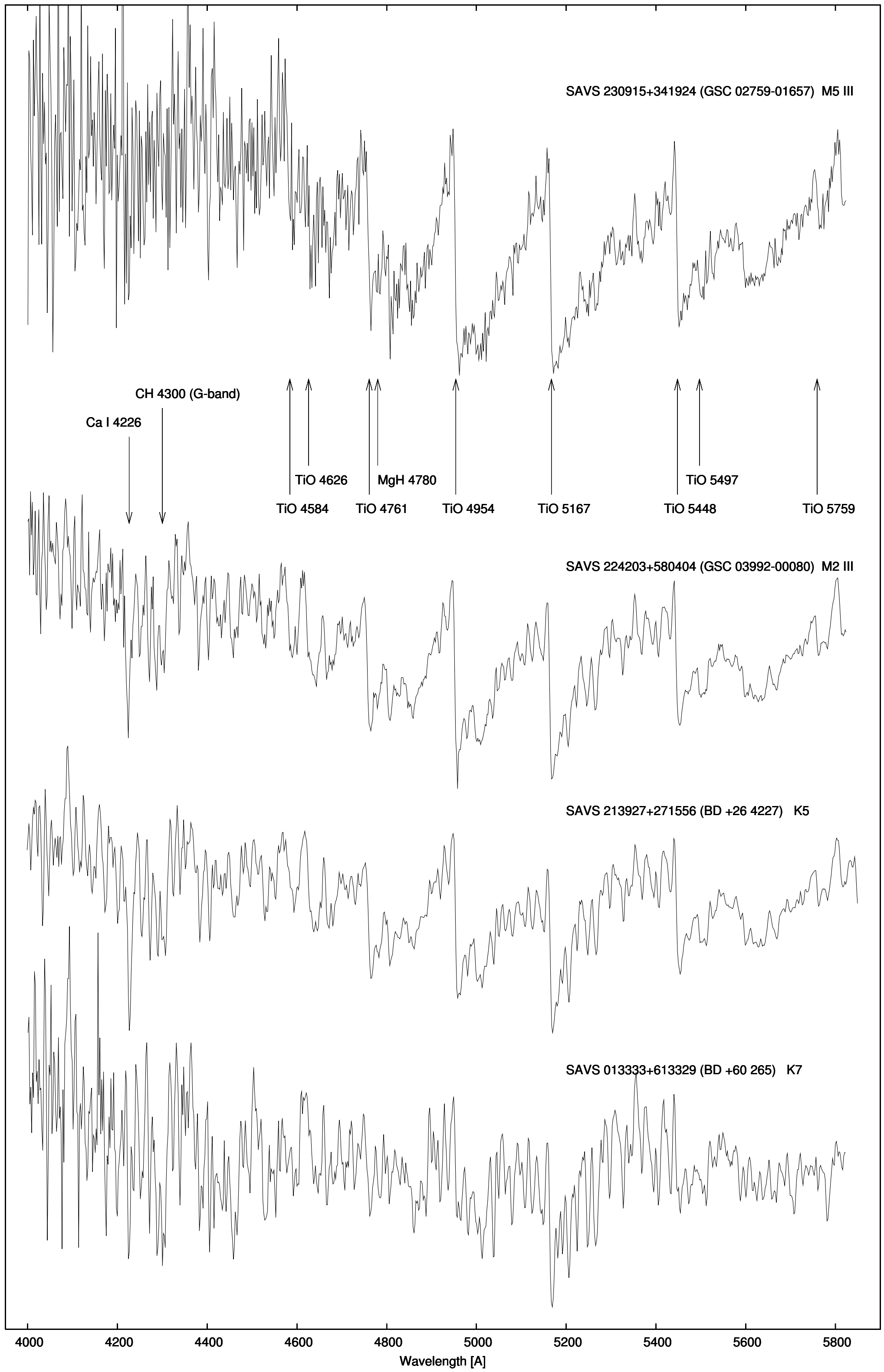

Figure 5. Spectra of several newly detected variables of late spectral type.

Table 2. Journal of spectroscopic observations. *SAVS ID* - identifier consisted of RA and Dec (J2000.0), *Other ID* - cross-identification with other catalogues, *HJD* - heliocentric Julian Date, *Exptime* - exposure time in seconds, $\lambda_1 - \lambda_2$ - wavelength range in Å, *Sp Type* - spectral type and luminosity class

SAVS ID	Other ID	*Date*	$HJD - 2450000$	$Exptime[s]$	$\lambda_1 - \lambda_2$	*Sp Type*
012728+290618	GSC 1754-1133	2004-01-18	3023.36884	1200	3725-5820	G5
013237+615811	BD+61°285	2004-01-15	3020.39014	1200	3725-5820	B2 V
013333+613329	BD+60°265	2004-01-15	3020.40665	1200	3725-5820	K7
213927+271556	BD+26°4227	2004-09-22	2905.41351	1200	3790-5845	M2 III
		2004-09-22	2905.42801	1200	3790-5845	
		2004-09-23	2905.51252	1200	5640-7700	
		2004-09-23	2905.52720	1200	5640-7700	
		2004-01-18	3023.22933	1200	3725-5820	
223446+581804	GSC 3995-1441	2004-01-15	3020.42474	1200	3725-5820	O9 V
223949+583254	HD 240017	2003-09-22	2905.38013	1200	3790-5845	B5 V
		2003-09-22	2905.39436	1200	3790-5845	
		2003-09-23	2905.54437	1200	5640-7700	
		2003-09-23	2905.55868	1200	5640-7700	
		2004-01-15	3020.36355	1200	3725-5820	
224203+580404	GSC 3992-80	2004-01-18	3023.30773	1200	3725-5820	M2 III
225956+350948	IRAS 22575+3453	2003-10-18	2931.37519	1200	5725-6730	Me III
		2003-10-18	2931.39148	1200	5725-6730	
		2003-10-18	2931.51110	1200	3985-5010	
230131+304427	GSC 2750-854	2004-01-18	3023.21266	1200	3725-5820	F5 V
230915+341924	GSC 2759-1657	2004-01-18	3023.34918	1200	3725-5820	M5 III
231034+314253	GSC 2751-1007	2004-01-18	3023.25182	1200	3725-5820	Ge
232358+313933	GSC 2752-1159	2004-01-18	3023.27144	1200	3725-5820	F5e V

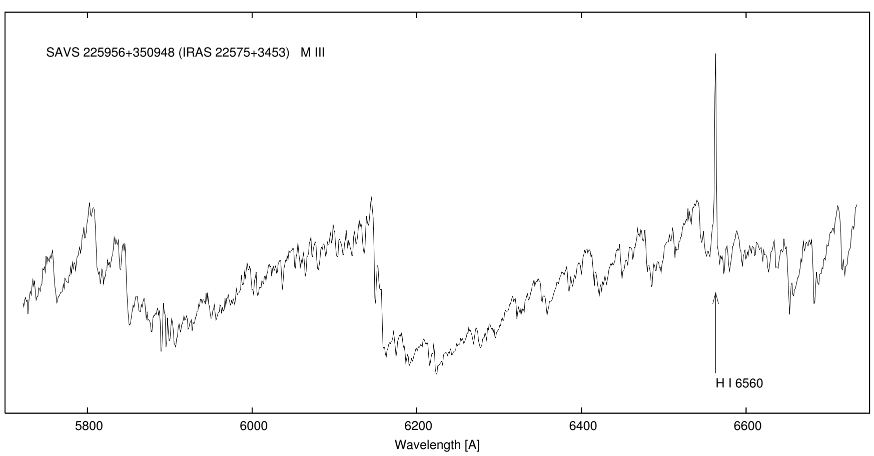

Figure 6. Higher resolution spectrum of IRAS 22575+3453 showing Hα emission.

COMMISSIONS 27 AND 42 OF THE IAU
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RAPID VARIATIONS IN V2275 Cyg (NOVA Cyg 2001#2)

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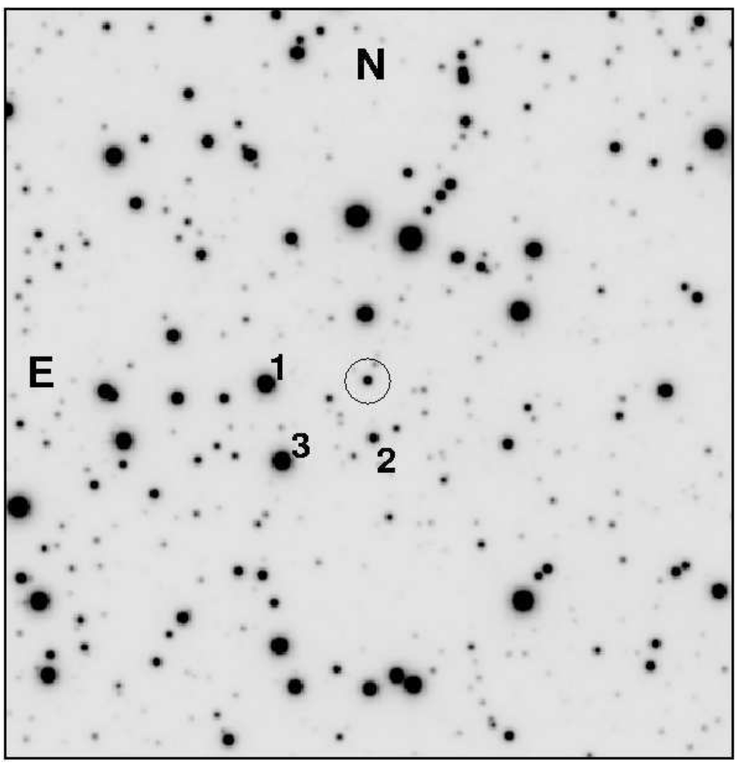

Figure 1. A finder chart for V2275 Cygni (circled) and comparison stars (listed in Table 1). The image is an average of 162 exposures, each 120 seconds in length. The field of view is 3.′5 on a side.

Nova Cygni 2001#2 was discovered by A. Tago and K. Matayama on Aug. 18 (Nakamura, 2001) at a magnitude of 6.6 . The brightness decay from maximum was one of the fastest ever recorded and it shows characteristics of recurrent novae (Kiss et al., 2002).

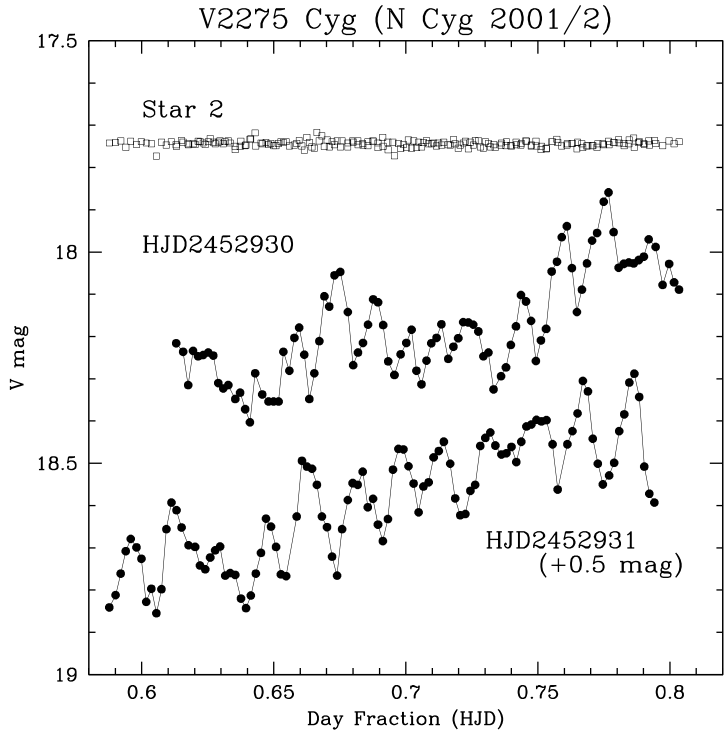

Figure 2. The V-band light curves of V2275 Cyg obtained with the VATT. The Oct. 19 data have been displaced by +0.5 mag.

Time resolved photometry in Oct. 2002 by Balman et al. (2003) revealed large amplitude variations with a period of 8 or 11 hours which might be associated with its orbital period.

We observed V2275 Cyg beginning on HJD2452930.61 (18 Oct 2003) with the 1.8-m Vatican Advanced Technology Telescope (VATT). This was 790 days after maximum light. Observations continued the next night starting at HJD2452931.59. The CCD was binned 2×2 providing a scale of 0.4 arcsec/pixel. V-band exposures were 120 seconds with 30 second readout time covering about 10 hours over the two nights. The resulting images were bias subtracted and flat-fielded and instrumental magnitudes were measured using aperture photometry. Three comparison stars near the nova (Figure 1) were also measured and their positions listed in Table 1. Approximate V-band magnitudes for the stars were estimated from zero-point and airmass coefficients measured at the VATT on earlier runs with standard magnitude errors estimated to be ±0.05 mag.

The VATT light curves shown in Figure 2 were obtained by subtracting the instrumental magnitude of Star 1 from the nova instrumental magnitude. The light curve for Star 2 relative to Star 1 is also shown and demonstrates both stars were constant over the observing run. Variations in individual measurements show an RMS scatter of 0.01 mag per exposure for $V \sim 18$ mag stars.

V2275 Cyg clearly shows light variations with a full amplitude of 0.2 mag and a period of about 20 minutes as well as a slower brightening trend on both nights. At the time of the observations V2275 Cyg varied between $18.0 < V < 18.5$ mag. The long-period variation suggests a period > 7 hours and may be the same phenomenon seen by Balman et al. (2003). The short period variation has not been previously observed and may be a quasi-periodic oscillation (QPO) or a stable periodicity such as a spinning white dwarf.

Power-spectrum analysis gives a period of 0.410±0.005 hours for the variation. A plot of this period against the normalized light curve is shown in Figure 3 and indicates that this period was stable over the two nights of data. This supports the possibility that the short-term light variations come from reprocessing of light from an asynchronous spinning white dwarf, but more data is needed to confirm the stability of the period.

We acknowledge travel assistance from the University of Notre Dame Department of Physics. This work based on observations with the VATT: the Alice P. Lennon Telescope and the Thomas J. Bannan Astrophysics Facility.

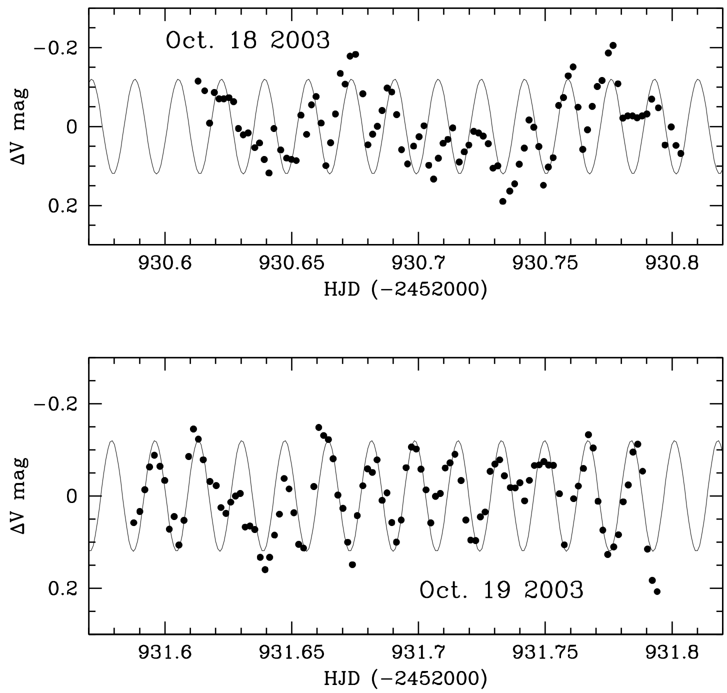

Figure 3. The normalized light curve compared to a sinusoidal oscillation with a period of 0.41 hours.

Table 1. Comparison Stars

Star	RA (2000)	Dec (2000)	V mag
1	21:03:04.80	+48:45:51	15.50
2	21:03:01.96	+48:45:37	17.75
3	21:03:04.38	+48:45:31	15.33

References:

Balman, S., et al. 2003, *IAU Circ*, 8074
Kiss, L.L., et al. 2002, *A&A*, **384**, 982
Nakamura, A. 2001, *IAU Circ*, 7686

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THE SOLAR TYPE NEAR CONTACT BINARY, CR CANIS MAJORIS

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As a part of our search for solar type eclipsing binaries with gas streams we observed the neglected variable, CR Canis Majoris [GSC 5973 1733, $\alpha(2000) = 7^{\rm h}18^{\rm m}2\overset{\rm s}{.}14$, $\delta(2000) = -19°40'57\overset{''}{.}7$]. Deurinck (1948) gave 16 times of minimum light and a starting ephemeris (recalculated by us),

$$\text{HJD Tmin I} = 2428094.488\ (\pm0.008) + 0.62414\ (\pm.00001)\text{d} \times \text{E}. \tag{1}$$

Standard errors in the last digits are given in parentheses. His photographic light curves suggest that CR CMa is a near contact binary.

The UBVRI light curves of CR CMa were taken at CTIO in Chile with the 0.9-m reflector on 27, 28, 30, 31, December 2002 and 1 January, by RGS. The CFIM 2K×2K T2K CCD camera was used, operating in a 1K×1K quad amplifier mode for fast readouts. Standard UBVR_cI_c Johnson-Cousins filters were used. The stars (GSC 5973 1418, $\alpha(2000) = 07^{\rm h}18^{\rm m}15\overset{\rm s}{.}25$, $\delta(2000) = -19°40'27\overset{''}{.}7$) and (GSC 5973 2291, $\alpha(2000) = 07^{\rm h}18^{\rm m}3\overset{\rm s}{.}86$, $\delta(2000) = -19°40'31\overset{''}{.}8$) were the comparison and check stars, respectively. A finding chart of CR CMa (V), the comparison (C) and check star (K) are given in Figure 1. 241 frames in B, 240 V, 238 R and I, and 242 in U were taken. The light curves and color curves of the variable are given in Figure 2 as normalized flux versus phase. Three mean epochs of minimum light were determined from U,B,V,R,I eclipse timings using parabola fits:

$$\begin{aligned}\text{HJD MIN II} &= 2452635.7345 \pm 0.0007\\ \text{HJD MIN I} &= 2452639.7905 \pm 0.0006\\ &= 2452641.6634 \pm 0.0008\end{aligned}$$

We calculated the following linear ephemeris from our observations:

$$\text{HJD Tmin I} = 2452641.6631\ (\pm0.0006) + 00.62408\ (\pm0.00010)\text{d} \times \text{E}. \tag{2}$$

A linear fit to the 19 available timings of minimum light gave:

$$\text{HJD Tmin I} = 2452641.6634\ (\pm0.0052) + 0.624141545\ (\pm0.0000002)\text{d} \times \text{E}. \tag{3}$$

Our light curves were phased with Equation 2. Our $B-V$ color indices indicated a spectral type of F3V for the variable and the comparison stars. The check star was G0V.

We first used Binary Maker 2.0 (Bradstreet, 1992) to pre-model the light curves. Both V1010 Oph and Algol semidetached configurations were tried. Only the second of these gave satisfactory fits to the light curves. This is the configuration where the smaller, cooler star fills its Roche lobe and the hotter primary star is under filling.

Using these starting values we calculated complete simultaneous 5 color synthetic light curve solutions with the Wilson Code (Wilson & Devinney 1971, Wilson 1990, 1994). Our best solution indicates that the primary component is under-filling its critical Roche lobe (fill-out = 89.76±0.07%) while the secondary component has reached its critical surface. Other parameters include temperature, T_1= 7000 K (fixed), T_2 = 4558 K, mass ratio m_2/m_1 = 0.34 and an inclination of 75.4 degrees. No spots were applied in our present solution. Our solution is shown overlaying the data in Figure 1. A geometrical representation of CR CMa is given in Figure 3.

If mass conservative transfer is taking place with the primary component as the gainer, the period would be increasing and the system is separating. However, the spectral type of the system may lead us to believe that magnetic breaking is acting which would lead to a decreasing period. These effects could be off setting. Plate archival searches and future monitoring of this system will be important providing clues to the actual orbital behavior.

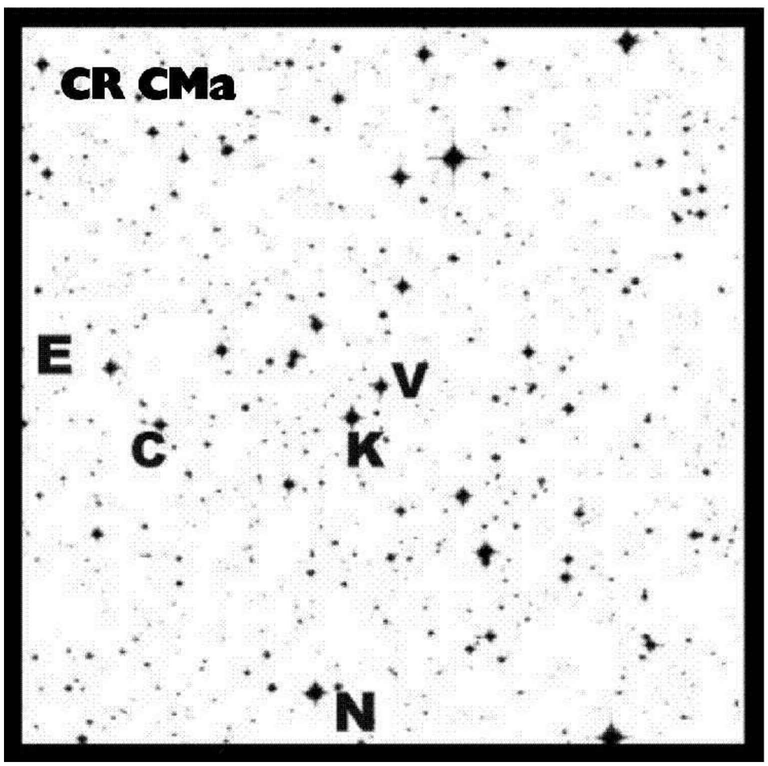

Figure 1.

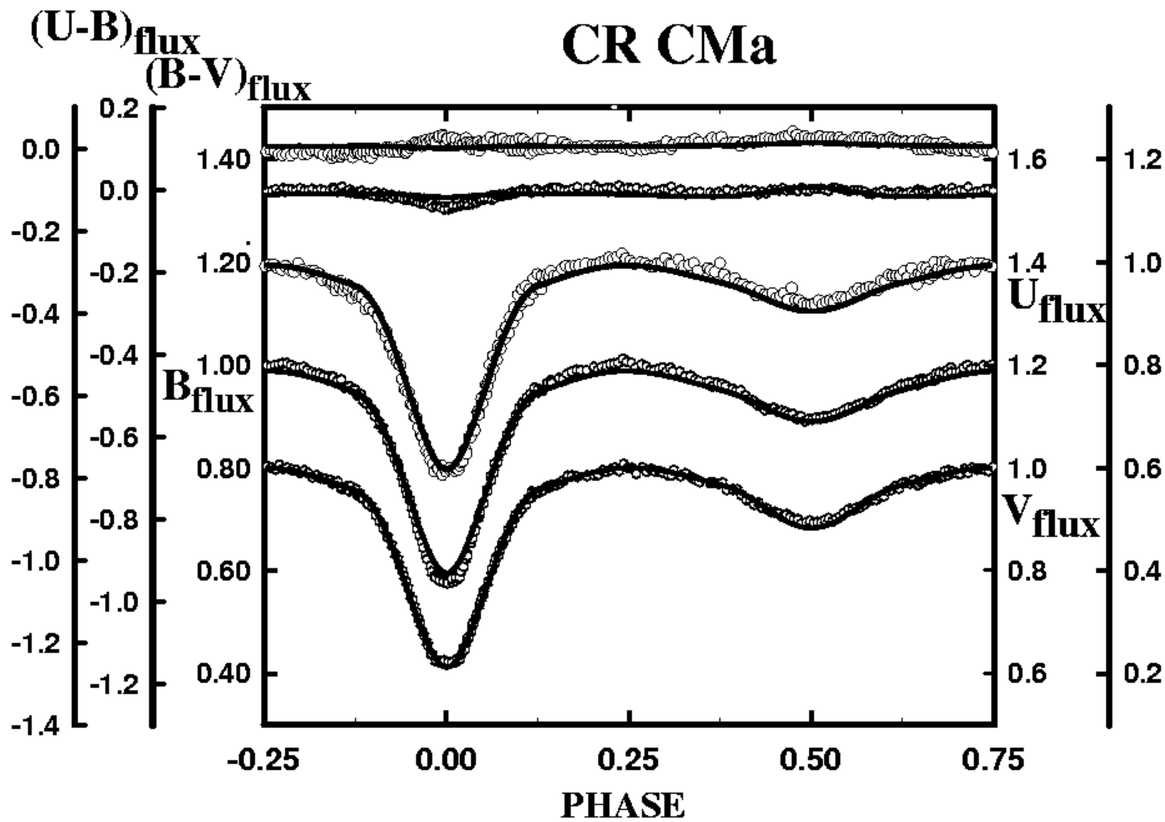

Figure 2.

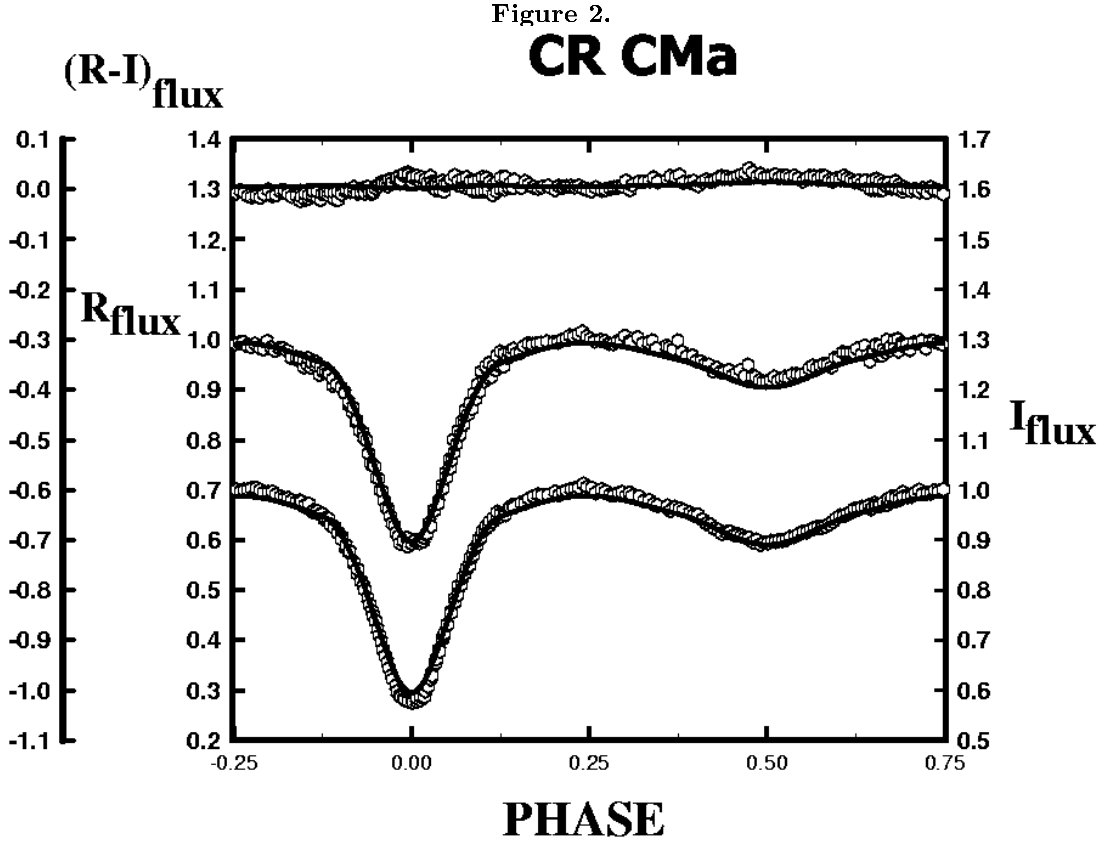

Figure 3.

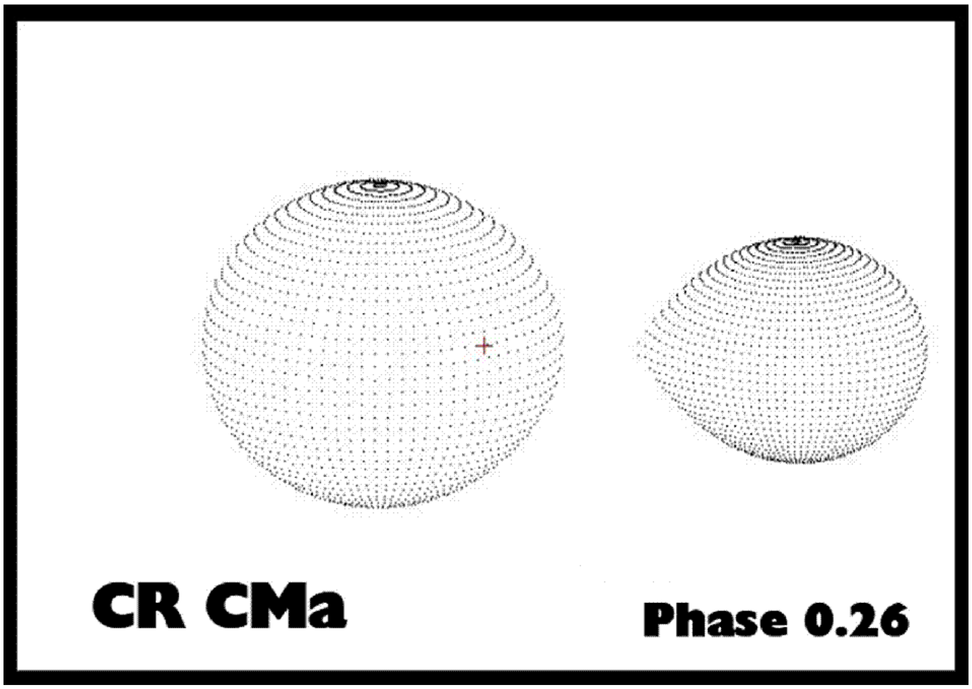

Figure 4.

We wish to thank CTIO for their allocation of observing time, and a small research grant from the American Astronomical Society which supported this run.

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COMMISSIONS 27 AND 42 OF THE IAU
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AN RR Lyr VARIABLE IN THE FIELD OF HX Peg

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Equatorial coordinates:	**Equinox:**
R.A.= $23^{h}40^{m}04\overset{s}{.}151$ **DEC.=** $12^{\circ}38'00\overset{''}{.}67$	J2000

Observatory and telescope:
U.S. Naval Observatory Flagstaff Station 1.0m

Detector:	SITe/Tektronix 1024×1024

Filter(s):	BV

Date(s) of the observation(s):
5 nights between UTD 030923 and 031021

Transformed to a standard system:	yes
Standard stars (field) used:	5521-t1.txt

Type of variability:	RRab

Remarks:

2MASSJ23400415+1238007 (= 2UCAC 36397461, USNO-B1.0 1026-0769191) is a star near the cataclysmic variable HX Peg. On September 20, 2003, Linnolt noticed an object in the HX Peg field that he had not seen before; this object was also confirmed by Simonsen. Over the course of several hours, Linnolt measured a brightness decline. The transient nature, plus a rough position at which no object was visible on archival plates, was sufficient to cause several professional observatories to respond to the alert. Henden commented in vsnet-alert that his all-sky field calibration indicated a variable object north of the Linnolt position, and further observations confirmed that this was the transient object observed by Linnolt: an RRab star that normally was below his observation limit, with a nearly integral-day-fraction period that caused "observing seasons" when the object would be bright enough to be visible. A finding chart based on a Keck LRIS (Oke et al., 1995) R-band image (courtesy of George Becker) is shown in Figure 1. Multifilter time-series photometry by Henden using the NOFS 1.0m telescope gives an epoch and period (errors in parenthesis) of

$$\text{max} = 2452904.868(1) + 0.50545(1) \times E$$

A B-band and V-band light curve is shown in Figure 2. The field calibration was performed on 6 nights (5 BV and one BVR_cI_c), using a large set of Landolt standard stars over wide color range and airmass. A preliminary version of this file was given in Henden and Honeycutt (1995). The variable was observed in all 4 BVR_cI_c filters on one occasion; the magnitude and colors are given below, with errors of 0.02mag in each measure.

Phase	V	$B-V$	$V-R$	$R-I$
0.787	15.915	0.453	0.320	0.344

The archival 2MASS observations yield the following magnitudes:

JD	J	Jerr	H	Herr	K	Kerr
2451135.7286	14.468	0.029	14.338	0.054	14.319	0.069

The $(J-H)$ and $(H-K)$ colors are typical of RRab variables.

Acknowledgements:

Some of the data presented herein were obtained at the W.M. Keck Observatory, which is operated as a scientific partnership among the California Institute of Technology, the University of California and the National Aeronautics and Space Administration. The Observatory was made possible by the generous financial support of the W.M. Keck Foundation. The authors wish to recognize and acknowledge the very significant cultural role and reverence that the summit of Mauna Kea has always had within the indigenous Hawaiian community. We are most fortunate to have the opportunity to conduct observations from this mountain.

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Henden, A. A., Honeycutt, R. K. 1995, *PASP*, **107**, 324.

Oke, J. B., Cohen, J. G., Carr, M., Cromer, J., Dingizian, A., Harris, F. H., Labrecque, S., Lucinio, R. ans W. Schaal 1995, *PASP*, **107**, 375.

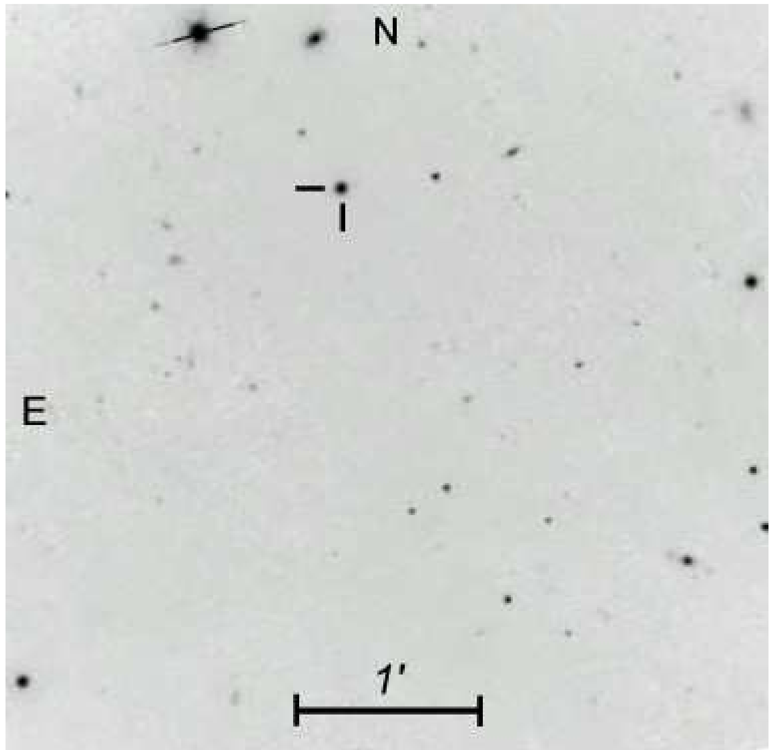

Figure 1. R-band finding chart. $4' \times 4'$

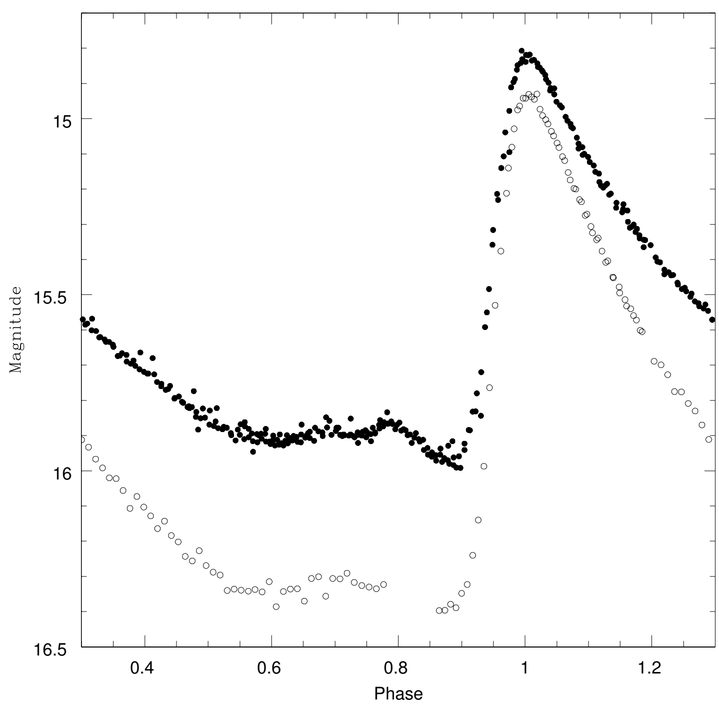

Figure 2. Light curve. Open circles are B, filled circles are V

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NEW GCVS DATA FOR SELECTED VARIABLES IN TELESCOPIUM

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In the course of our work on revision of positional information for all stars of the GCVS (Samus et al., 2002, 2003), we finished identifications with positional catalogs for variables in the constellation Telescopium. With accurate coordinates for these stars, we were able to retrieve their observations from the ASAS-3 data base (Pojmanski, 2002), often the only source of data making it possible to study sufficiently bright southern variables. These observations were analyzed using the period-search software developed by Dr. V.P. Goranskij for Windows environment. As a result, we obtained information significantly appending or improving that in the GCVS for 75 stars (of 350 GCVS variables, including those from the Name-Lists, in this constellation). In 57 cases, even the variability types were modified or completely changed. The relevant data are presented in Table 1. For short-period stars, the light elements in the Table are heliocentric. The epochs are minima for eclipsing and RV Tauri stars and maxima for other variables. Figures 1 and 2 contain sample light curves, plotted using ASAS-3 V-band observations, for some of the variables. Probably the most interesting of them are the two new RV Tauri stars, HI and NW Tel, earlier classified respectively as E: and I:, and a very-short-period CWB (or a very-long-period RR) variable PP Tel ($P = 1\overset{d}{.}1$).

The information presented in this paper, along with accurate coordinates for all other GCVS stars in Telescopium, will be incorporated in the GCVS on-line version in May, 2004.

We wish to express our sincere thanks to Dr. V.P. Goranskij for providing us with his excellent period-search software. Thanks are due to Dr. M.L. Hazen for sending us many unpublished finding charts for Harvard variables. The work of the GCVS team is supported, in part, by grants from the Russian Foundation for Basic Research (grant 02-02-16069), The Federal Scientific and Technological Program "Astronomy", the program "Non-Stationary Processes in Astronomy" of the Presidium of Russian Academy of Sciences, and the program of support for leading scientific schools of Russia (grant NSh-389-2003-2).

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Samus, N. N., Goranskii, V. P., Durlevich, O. V. *et al.*, 2003, *Astronomy Letters*, **29**, 468

Table 1. New data on the variable stars in Telescopium

Star	RA (J2000)	Dec	Type	V	Epoch, JD 24...	P, days
RX	19 06 58.2	–45 58 14	LC	7.0– 8.7		
TZ	18 10 30.2	–54 59 46	SRA	11.9–13.3	52172	202
UX	18 16 34.8	–51 34 15	SRA	13.0–14.7	52432	201
UZ	18 17 40.1	–50 11 19	SRA	12.5–14.2	52082	190
VW	18 19 05.1	–56 54 47	SRA	12.4–14.6	52759	74
VX	18 18 41.7	–52 35 11	SRA	12.7–14.0	52898	117
XX	18 29 10.1	–56 42 00	SRB	12.2–12.9		46:
YZ	18 36 13.3	–50 38 14	SR	12.1–13.0		73:
AC	18 39 16.8	–56 39 44	SRA	11.9–13.8	52954	252
AE	18 39 42.7	–53 13 35	SRB	11.9–13.0		76:
AF	18 40 39.2	–56 06 01	SRB	11.6–12.6		96:
AG	18 41 12.8	–51 57 50	SRA	11.4–12.7	52453	115
AI	18 42 01.9	–50 06 30	SRA	11.9–12.4	52713	55
AK	18 43 48.8	–55 00 23	SRA	13.4–15.1	52919	150
AL	18 44 34.8	–53 28 15	SRA	11.8–13.5	52868	63.4
AN	18 46 39.1	–55 21 13	SRB	10.5–11.0		235 and 27
AO	18 46 30.5	–50 42 04	SRB	10.7–12.0		121:
AP	18 47 48.0	–55 33 05	M	10.7–(14.5	52930	156
AQ	18 49 17.2	–51 36 05	RRC	13.2–13.7	52122.637	0.32078
AS	18 49 31.3	–49 15 16	M	11.3–(14.6	52032	183
AT	18 50 02.6	–51 38 05	CWB	13.7–14.6	53067.89	1.97:
AU	18 50 03.7	–49 56 01	SRA	11.4–13.1	52787	159
AV	18 50 24.0	–50 51 35	EW	13.2–14.3	52415.861	0.416963
AY	18 15 26.1	–54 29 53	M	11.3–(14.5	52839	221
BC	18 24 05.0	–50 27 08	M	10.9–(13.9	52756	176
BE	18 27 19.9	–50 05 49	M	11.5–(14.3	52089	173
BG	18 27 57.4	–53 35 07	M	11.2–(14.1	52171	245
BH	18 49 31.7	–49 54 30	M	10.0–(14.3	52912	217
BK	18 47 40.5	–46 08 17	SRA	10.4–13.0	52509	153
BM	19 07 40.9	–50 02 42	M	11.4–(14.5	53088	391
BN	19 09 49.9	–48 09 23	M	10.3–14.1	52878	282
BR	20 23 59.9	–52 52 12	SRD	9.6–10.9		107:
CP	18 16 57.4	–54 54 58	RRAB	13.4–14.1	52535.518	0.47651
CT	18 17 36.2	–53 18 25	SRB	12.6–13.7		91:
CY	18 19 38.2	–51 29 52	RRAB	13.0–13.9	52725.785	0.43280
EE	18 28 58.5	–56 13 57	RRAB	13.1–14.4	52831.746	0.46794
EV	18 33 55.3	–51 21 11	RRAB	12.3–13.8	52838.805	0.44194
FG	18 36 03.5	–50 20 27	M	12.2–(15.3	52191	177
FL	18 36 53.7	–49 24 38	EB	14.0–14.8	52875.697	0.51178
FP	18 40 38.4	–52 45 24	RRAB	13.1–14.1	52865.751	0.40081
FR	18 41 49.6	–51 51 26	SRA	12.0–13.8	52500	174
FT	18 42 41.5	–52 50 52	RRAB	13.1–13.8	52415.840	0.64809
FU	18 43 23.7	–54 58 50	RRAB	12.5–13.8	52104.647	0.35969
GK	18 48 21.6	–49 35 04	RRAB	13.5–14.0	52428.715	0.81346
GR	18 52 22.3	–53 09 50	RRAB	12.4–13.4	52888.623	0.61196
GS	18 31 33.9	–47 52 42	M	12.1–(15.2	51985	329
GT	18 34 57.9	–52 35 10	RRAB	12.9–14.3	52081.660	0.40751
GU	18 35 29.3	–49 46 30	M:	12.5–(13.8	52178	166:
GV	19 02 20.1	–47 31 44	M	11.4–(15.4	52690	261
GW	19 30 12.8	–45 17 33	M	11.3–(14.6	52193	146
HI	18 55 22.6	–52 45 04	RVA	10.6–11.9	52955.5	66.5
HK	19 06 50.1	–52 29 43	SRA	10.8–12.6	52890	96
HL	19 31 05.6	–50 23 47	M	10.9–(14.3	52718	209
HM	19 34 10.5	–49 10 46	EA	12.0–13.8	52192.545	6.2318
HQ	19 55 12.2	–56 28 33	M	12.8–(14.7	52708	286
HT	20 00 17.2	–45 18 53	RRAB	12.9–14.1	52867.778	0.61658
LU	18 21 08.3	–46 32 57	EA	12.4–13.5	52086.66	1.57173
MS	18 31 11.1	–48 51 20	RRAB	13.4–13.9	52739.85	0.70897

Table 1. (Continuation)

Star	RA (J2000)	Dec	Type	*Mag*	Epoch, JD 24...	P, days
MZ	20 07 45.7	–53 25 56	RRC	13.9–14.4	52902.501	0.35952
NR	18 31 12.9	–49 04 58	M	10.7–14.8	52839	196
NT	19 22 52.1	–50 23 23	M	10.3–(14.4	52152	261
NU	18 12 58.9	–55 08 15	SRA	12.3–13.5	52841	61
NW	18 19 43.9	–51 15 53	RVA	11.0–12.1	52184.5	68.9
NY	19 06 02.2	–47 14 35	SRB	10.4–11.4		75:
NZ	19 23 01.6	–48 35 52	M	10.7–14.7	52931	195
OP	18 23 13.2	–47 06 04	M	12.0–(14.3	52487	162
OU	18 45 15.5	–49 13 59	SRA	10.8–11.7	52935	75
OV	18 45 50.2	–47 55 55	RRAB	12.9–14.4	52759.878	0.62789
OW	18 54 24.9	–46 08 36	M	10.6–14.3	52878	225
OX	19 14 55.9	–47 35 05	M	11.5–(14.4	53075	290
OY	19 39 28.7	–52 51 24	SRA	9.5–10.7	52195	123
PP	20 16 56.5	–51 15 11	CWB	12.8–14.2	52861.66	1.09068
PQ	19 10 25.4	–51 15 18	M	10.7–(14.5	52741	240
PY	18 22 36.3	–48 45 32	SRA	10.6–12.4	52814	266
QT	19 55 54.7	–51 23 30	SRB	12.6–14.4		140:

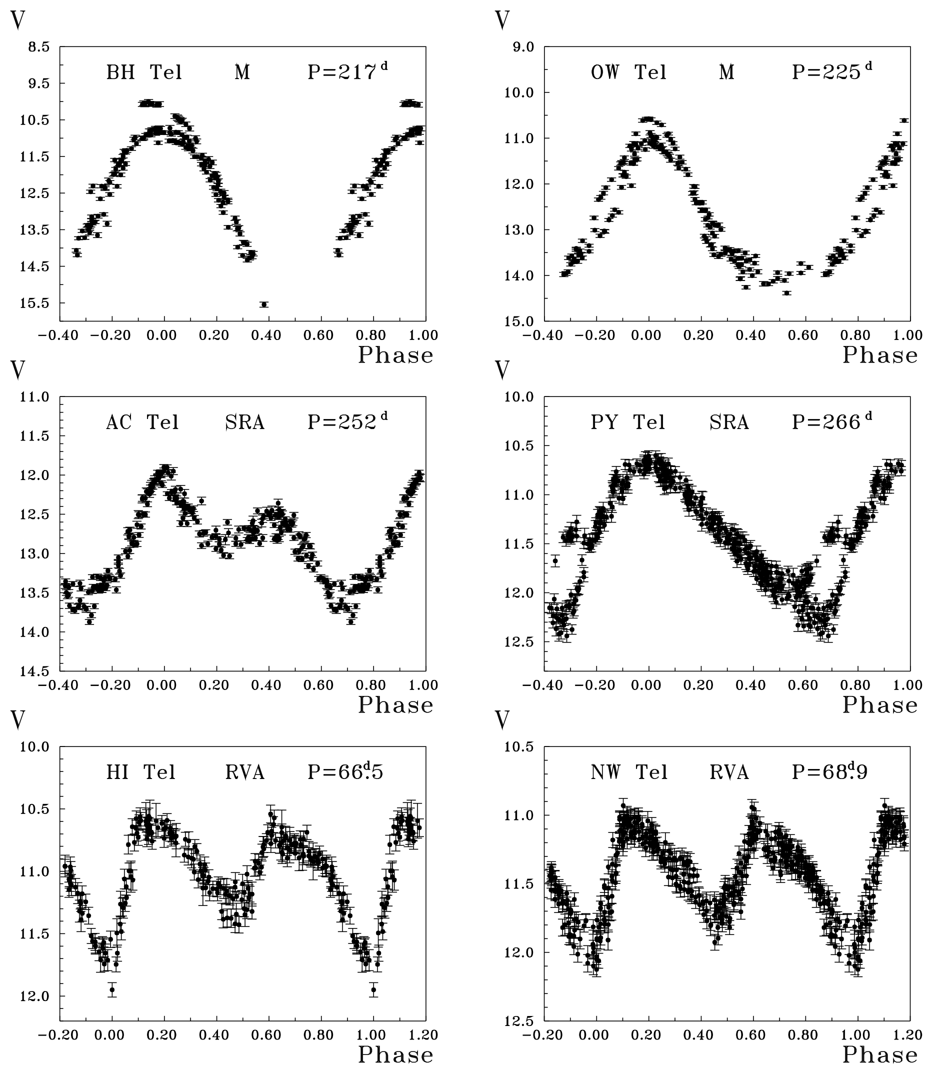

Figure 1. The sample light curves for 6 variables in Telescopium.

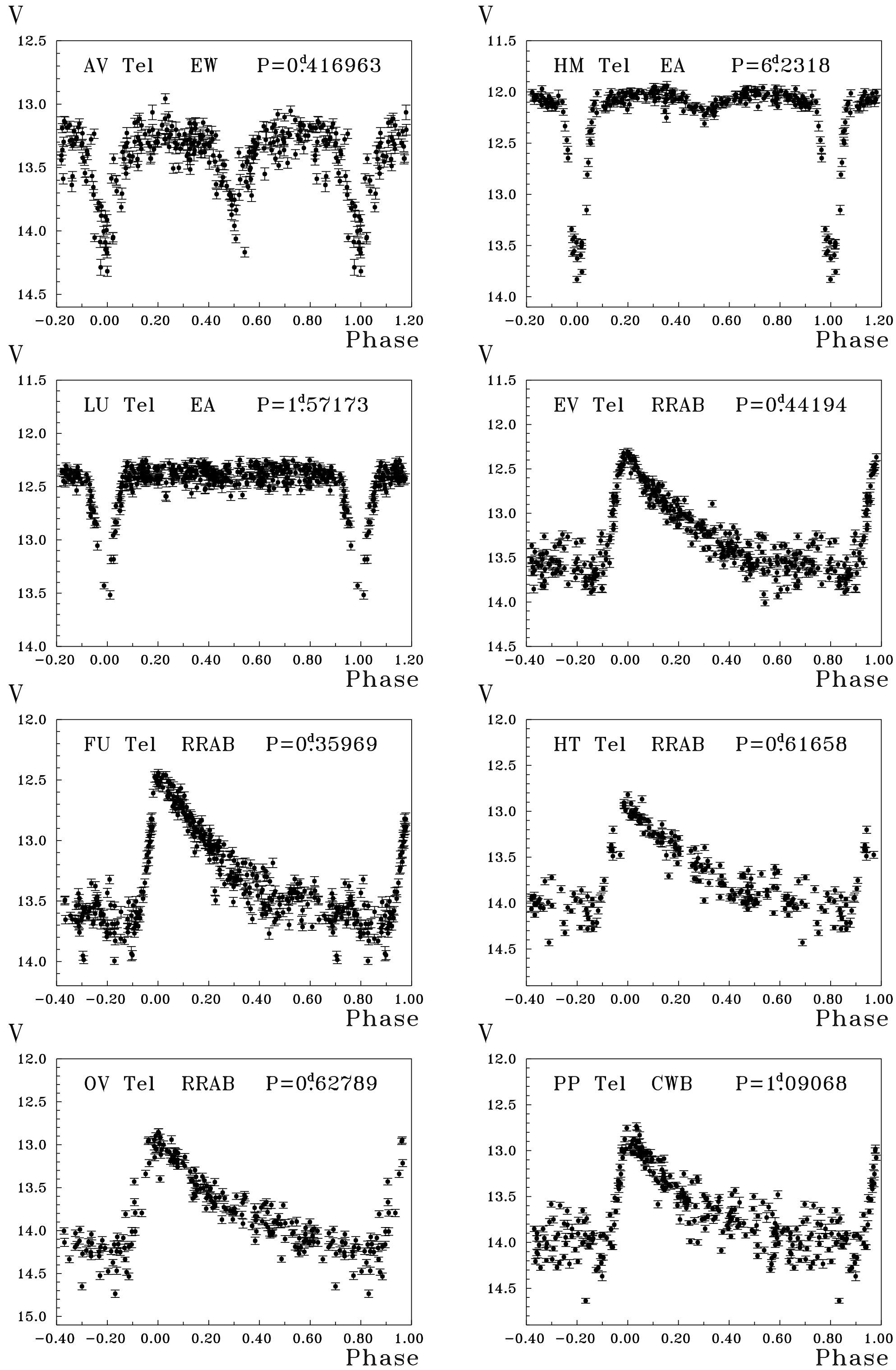

Figure 2. The sample light curves for 8 variables in Telescopium.

COMMISSIONS 27 AND 42 OF THE IAU
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FOUR RR LYRAE STARS WITH VARIABLE PERIODS IN OPHIUCHUS

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The discovery of the variability of these stars has been reported by Hoffmeister (1966, 1967). No ephemeris is known for V1089 Oph until today and, in the other cases, the published elements were outdated because of strong period variations. Photographic plates of a field centered around 67 Oph, taken with the Sonneberg Observatory 40cm Astrograph during three intervals spread over the years from 1938-1994, were used to check the behaviour of these objects (see Table 1). The elements listed below were obtained by means of least-squares solutions. Published times of maximum for V1083 Oph, V1093 Oph and V1095 Oph (Savin 1988a,b and Surikov 1982) were included in this analysis.

Photographic amplitudes were derived with respect to magnitudes of the comparison stars given in Table 2. Individual data are available upon request.

Remarks:

V1083 Oph

The ephemeris published by Savin (1988a) has been found in need of improvement. Now, the elements listed in Table 1 are valid for J.D. 2429100-2441200 and J.D. 2444000-2449500 resp. A supplementary quadratic solution is given because this represents the given minima timings in a comparable way like the linear ones. This set of elements is valid over the whole interval.

V1089 Oph

Elements valid (1982) for J.D. 2429700-2449500. Due to a apparent companion the minimal magnitudes are somewhat uncertain. Unfortunately there were not enough older plates available to determine the date of the period change as well as the value of the period acting in the time before the interval mentioned above.

V1093 Oph

First elements were derived by Savin (1988b); the GCVS lists an E0 according to Hoffmeister(1966) and an erroneous period of 4.03 days. Our elements given below are at least valid for an interval of JD 2438200-2449500. The same problem as described in the case of V1089 Oph appeared for the period change. Only the observations from J.D. 2438258-2449488 were displayed in the light curve (Fig. 5) because of the uncertainties concerning the set of elements valid prior to this date.

V1095 Oph

First elements were derived by Surikov. According to our observations the period turned out to be variable. Elements are valid for J.D. 2425400-2430000 and J.D. 2439000-2449500 resp. A quadratic fit was applied for the same reasons like in V1083 Oph.

Table 1. Summary of this paper

Star	Type	Epoch 2400000+	Period (day)	Quad. Term $*10^{-10}$	Max.	Min.	M−m	No. of Plates
V1083 Oph (1)	RRab	38258.418 ±15	0.5522898 ±7		$15^{m}.3$	$16^{m}.7$	$0^{p}.20$	88
V1083 Oph (2)		47418.375 ±14	0.5523085 ±25					40
V1083 Oph (3)		47418.380 ±12	0.5523132 ±20	5.0 ±6				128
V1089 Oph	RRab	49475.521 ±5	0.6045402 ±5		$13^{m}.9$	$14^{m}.9$:	$0^{p}.16$	260
V1093 Oph	RRab	48830.443 ±10	0.4488517 ±8		$15^{m}.2$	$16^{m}.5$	$0^{p}.18$	82
V1095 Oph (1)	RRab	25864.342 ±7	0.4587875 ±12		$14^{m}.2$	$15^{m}.8$	$0^{p}.23$	32
V1095 Oph (2)		47390.485 ±5	0.4587798 ±6					195
V1095 Oph (3)		47390.485 ±5	0.4587778 ±7	-1.8 ±2				227

Table 2. Comparison stars and cross references

	V1083 Oph S 9276 USNO 0900-11201195		V1089 Oph S 9862 USNO 0900-11607658	
Comp. No.	USNO	m*	USNO	m*
1	0900-11206973	$14^{m}.8$	0900-11599684	$14^{m}.0$
2	0900-11199346	$16^{m}.2$	0900-11610001	$14^{m}.7$
3	0900-11197315	$16^{m}.4$	0900-11600524	$14^{m}.7$
4			0900-11604592	$15^{m}.2$

	V1093 Oph S 9295 USNO 0900-11721789		V1095 Oph S 9868 USNO 0900-11914415	
Comp. No.	USNO	m*	USNO	m*
1	0900-11718573	$15^{m}.4$	0900-11926326	$14^{m}.1$
2	0900-11722387	$16^{m}.0$	0900-11919647	$14^{m}.4$
3	0900-11725709	$16^{m}.5$	0900-11909524	$15^{m}.3$
4			0900-11909673	$15^{m}.5$

* Magnitudes refer to the B values of the USNO−A2.0 catalogue

This research made use of the SIMBAD data base, operated by the CDS at Strasbourg, France.

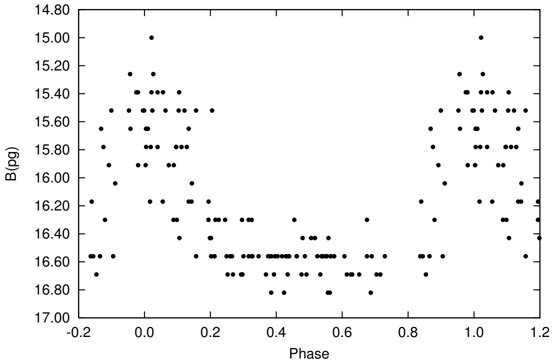

Figure 1. Composite light curve of V1083 Oph

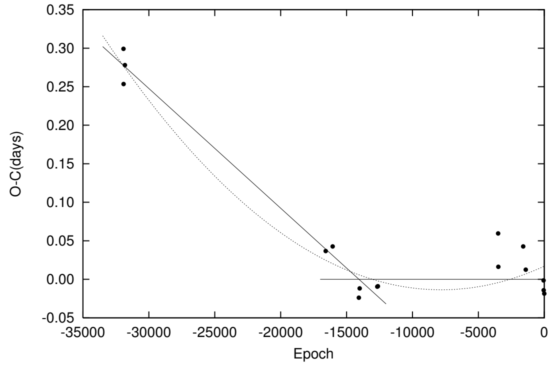

Figure 2. (O−C) diagram for V1083 Oph

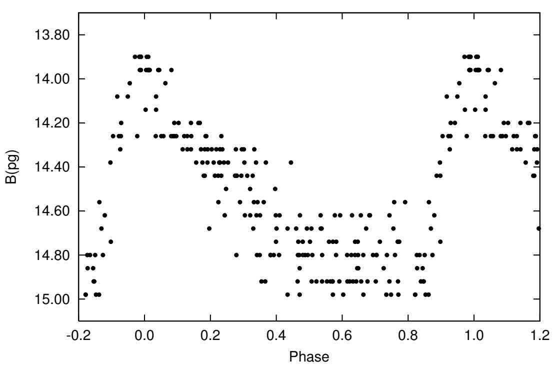

Figure 3. Composite light curve of V1089 Oph

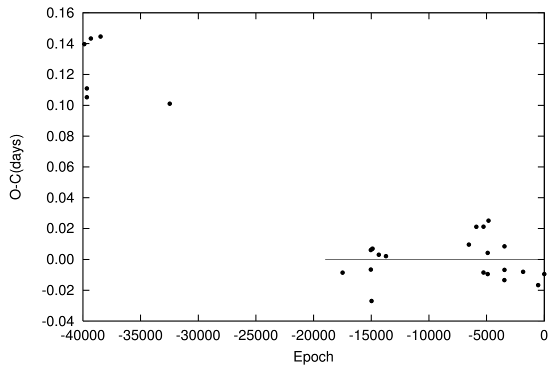

Figure 4. (O−C) diagram for V1089 Oph

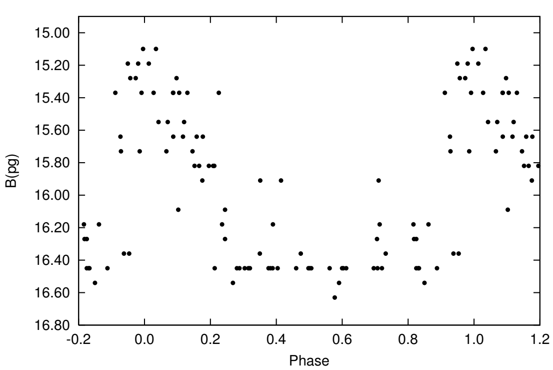

Figure 5. Light curve (J.D. 2438258 − 2449488) of V1093 Oph

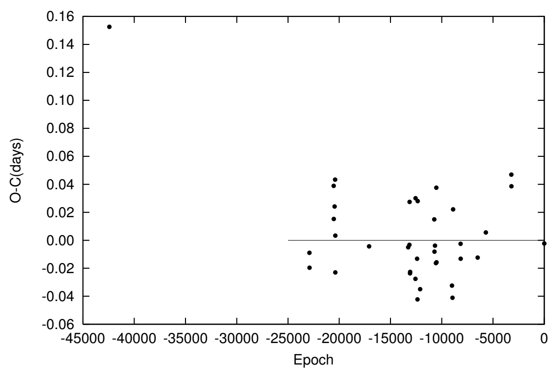

Figure 6. (O−C) diagram for V1093 Oph

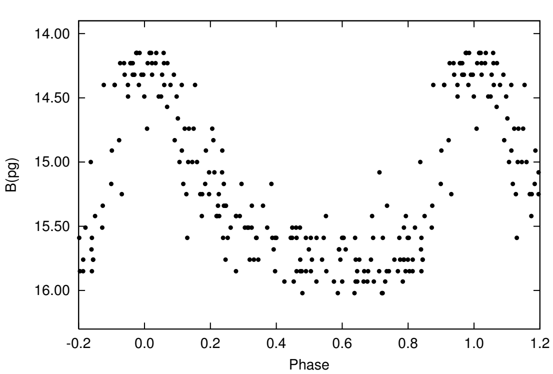

Figure 7. Composite light curve of V1095 Oph

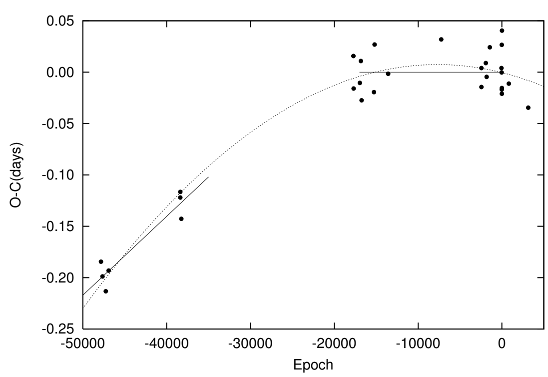

Figure 8. (O−C) diagram for V1095 Oph

Table 3. Heliocentric times of new found maxima and $O-C$ values according to the elements derived in this paper

Star	JD (max.*)	Epoch	$O-C$	Star	JD (max.*)	Epoch	$O-C$
V1083 Oph (1)	29787.418	−15338	0.022	V1093 Oph	38549.486	−22905	−0.009
	29788.477	−15336	−0.024		38553.515	−22896	−0.020
	29845.389	−15233	0.003		39611.517	−20539	0.039
	38258.415	0	−0.003		39615.533	−20530	0.015
	38549.486	527	0.012		39651.450	−20450	0.024
	39648.507	2517	−0.024		39673.463	−20401	0.043
	39684.419	2582	−0.011		39681.476	−20383	−0.023
	40418.435	3911	0.012		39682.400	−20381	0.003
	40444.394	3958	0.013		41160.461	−17088	−0.004
V1083 Oph (2)	45486.458	−3498	0.058		45912.446	−6501	−0.012
	45492.490	−3487	0.015		46272.443	−5699	0.006
	46533.612	−1602	0.035		47387.432	−3215	0.047
	46642.386	−1405	0.004		47392.361	−3204	0.039
	47387.432	−56	−0.014		48830.441	0	−0.002
	47392.390	−47	−0.026	V1095 Oph (1)	25440.438	−924	0.016
	47418.344	0	−0.031		25525.298	−739	0.000
V1089 Oph	25363.576	−39885	0.140		25705.584	−346	−0.017
	25495.337	−39667	0.111		25864.342	0	0.000
	25498.354	−39662	0.105		29786.522	8549	0.006
	25707.563	−39316	0.143		29787.445	8551	0.011
	26215.378	−38476	0.145		29843.390	8673	−0.016
	29844.389	−32473	0.101	V1095 Oph (2)	39259.546	−17723	0.016
	38901.500	−17491	−0.009		39270.525	−17699	−0.016
	40381.429	−15043	0.006		39615.533	−16947	−0.010
	40384.439	−15038	−0.007		39672.443	−16823	0.011
	40419.482	−14980	−0.027		39711.401	−16738	−0.027
	40453.370	−14924	0.007		40384.439	−15271	−0.019
	40473.320	−14891	0.007		40418.435	−15197	0.027
	40803.395	−14345	0.003		41163.465	−13573	−0.002
	41179.418	−13723	0.002		44069.410	−7239	0.032
	45522.442	−6539	0.010		46271.507	−2439	−0.014
	45912.382	−5894	0.021		46272.443	−2437	0.004
	46288.406	−5272	0.021		46509.637	−1920	0.009
	46291.399	−5267	−0.009		46554.584	−1822	−0.005
	46506.628	−4911	0.004		46731.243	−1437	0.024
	46509.637	−4906	−0.010		47368.468	−48	0.004
	46552.594	−4835	0.025		47380.392	−22	0.000
	47381.380	−3464	−0.013		47385.422	−11	−0.017
	47387.432	−3454	−0.007		47386.383	−9	0.027
	47390.470	−3449	0.008		47390.470	0	−0.015
	48362.554	−1841	−0.008		47391.382	2	−0.021
	49154.493	−531	−0.017		47392.361	4	0.040
	49475.511	0	−0.010		47770.344	828	−0.011
V1093 Oph	29788.511	−42424	0.153		48832.396	3143	−0.035

* Mid-exposure times of plates with brightest observations

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Number 5524

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HU ISSN 0374 – 0676

TU UMi: A CONTACT BINARY IN A TRIPLE SYSTEM

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Photometric variability of the star BD+76 544 (HIP 73047, $V \simeq 8.8$ mag.) was discovered by the Hipparcos mission. In the Variability Annex of the Hipparcos Catalogue (ESA, 1997), the star has been assigned the name TU UMi. The full, peak-to-peak amplitude of the variability is about 0.06 mag. and quality of the light-curve is rather poor. Consequently, TU UMi could only be classified as a periodic variable with the period 0.188546 days. Duerbeck (1997) used the period-color relation for contact binaries (Rucinski, 1993) to search for contact binary candidates in the Variability Annex of the Hipparcos catalogue (ESA, 1997). TU UMi was found to be one of them and listed with the doubled period. Nevertheless the possibility of it being a pulsating variable could not be ruled out. In fact, the star has been included in the catalogue of δ Sct stars (Rodríguez et al., 2000).

In the nights 2003 March 26/27 UT, April 09/10 UT and April 11/12 UT, TU UMi was observed spectroscopically at the David Dunlap Observatory, University of Toronto. The obtained spectra have been analyzed using a broadening-function method (Rucinski, 2002). Figure 1 presents a map of broadening-functions plotted against corresponding orbital phases. The most pronounced feature in this plot has a constant radial velocity of about +30 km s^{-1}. It corresponds to the third body in the system. The peak of the signature of the primary (more massive) component in the close binary is roughly five times lower than the peak corresponding to the third body. This broad feature is best visible at the phases around 0.25 at radial velocities in the range from -50 km s^{-1} to $+150$ km s^{-1}. The peak of the signature of the secondary component of the close binary is over ten times lower than the peak corresponding to the third body and is barely detectable in the figure. This feature is visible at phases around 0.25 with radial velocities about -150 km s^{-1} and at phases around 0.75 with velocities about $+200$ km s^{-1}. The plot clearly shows that TU UMi is a triple system containing a close binary. The small amplitude of the photometric variability is explained, at least in part, by the fact that about 55% of the total light comes from the companion star ($L_3/(L_1 + L_2) = 1.25 \pm 0.15$). This causes difficulties in the analysis of the spectroscopic data with large uncertainties in the K_i amplitudes. The results will be published in the 10-th paper of the DDO spectroscopic radial-velocity series (Rucinski et al., 2004).

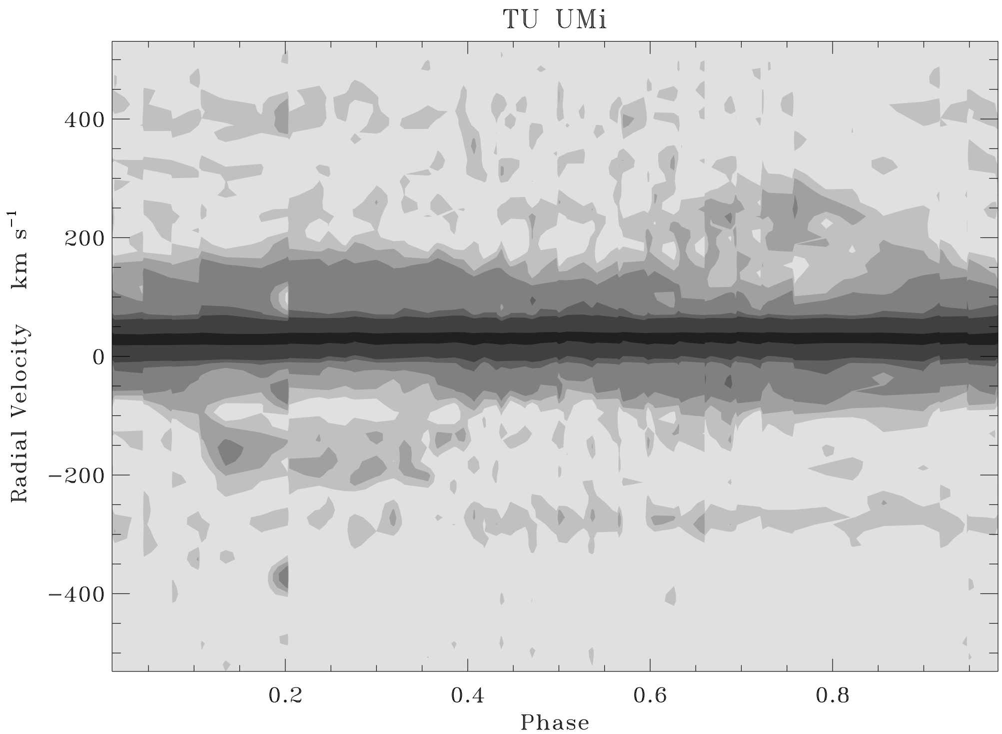

Figure 1. Broadening-functions

Simultaneously with the spectroscopic observations, we conducted unfiltered photometry of TU UMi. We were using a 15 cm refractor finder of the main 1.88m telescope, equipped with SBIG ST-6 CCD camera. The data have been reduced using procedures within IRAF[1] package. The aperture photometry has been done using DAOPhotII package (Stetson, 1987). Figure 2 presents the finding chart from our observations. The size of the field is about 18×15 arc minutes. The sum of the light from stars marked as C1 and C2 has been used as the comparison for differential photometry. Phased light-curve is presented in Figure 3. The times of the minimum were calculated using Kwee and van Woerden (1956) method and are listed in Table I. A linear least squares fit to our times of minimum yields the following linear ephemeris:

$$\mathrm{HJD\ MIN} = 2452725.6262(64) + 0.37730(19) \times E$$

Since the temporal spacing between time of the minimum from the Hipparcos Catalogue (HJD=2448500.0690) and our observations is longer than 10,000 orbits, we are not able to predict this number with a precision better than 2 orbits. Thus we cannot calculate the mean orbital period based on both sets of photometric data.

We would like to thank H. DeBond and J. Thomson, the telescope operators at David Dunlap Observatory for their cooperation during observations. We also thank J. Thomson for help in the preparation of the article. This study has been done while W. Pych held the NATO Post-Doctoral Fellowship administered by the Natural Sciences and Engineering Council of Canada (NSERC). The research was also supported by the NSERC grant to S. M. Rucinski.

[1]IRAF is distributed by the National Optical Astronomical Observatories, operated by the Association of Universities for Research in Astronomy, Inc., under contact with the National Science Foundation

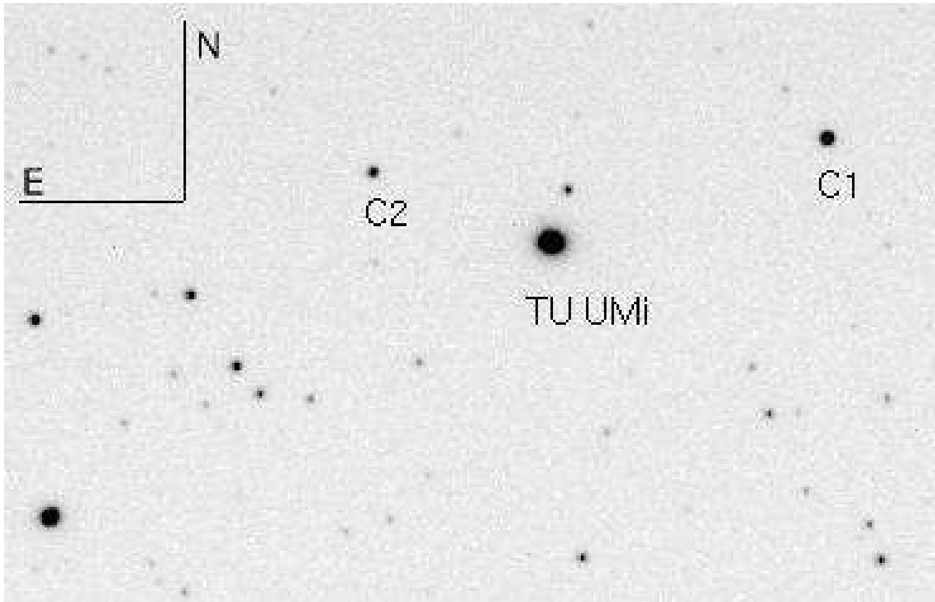

Figure 2. Finding chart

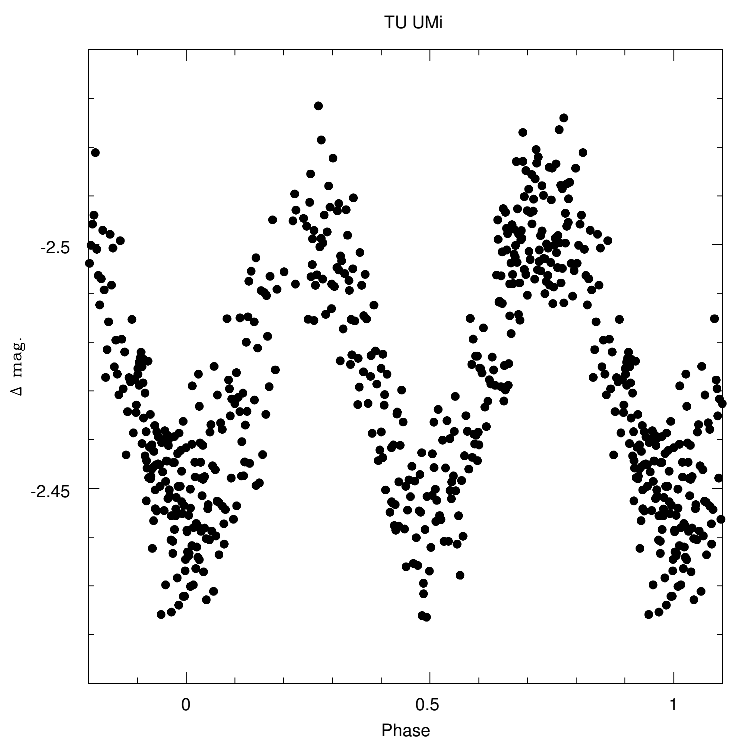

Figure 3. Light-curve

Table I. Times of Minimum of TU UMi, 2003

Type	HJD (2450000.+)	Error	Epoch	O-C
Primary	2725.62604	0.00035	0.0	-0.000166
Primary	2739.59307	0.00036	37.0	0.006779
Secondary	2739.76890	0.00076	37.5	-0.006041
Secondary	2741.66087	0.00029	42.5	-0.000569

References:

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Number 5525

Konkoly Observatory
Budapest
27 April 2004

HU ISSN 0374 – 0676

CCD LIGHT CURVES OF ROTSE1 VARIABLES, XXI: GSC 3108:57 Lyr, GSC 3526:1995 Lyr, GSC 3109:859 Lyr, AND GSC 3526:2369 Lyr

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[2] BBSAG, Rennweg 1, CH-4118 Rodersdorf, Switzerland; e-mail: diethelm@astro.unibas.ch

Observatory and telescope:
Private observatory Schüsselacher, Wald, 0.15-m Starfire refractor

Detector:	SBIG ST-7 CCD camera

Method of data reduction:
Standard CCD-frame reduction using AIP4WIN software

Method of minimum determination:
Kwee – van Woerden algorithm

Observed star(s):

Star name	GCVS type	Coordinates (J2000) RA	Dec	Comp./check star(s)
GSC 3108:57				
ROTSE1 J182345.43+410547.6	EW	18 23 45.4	+41 05 48	GSC 3108:471 / GSC 3108:607
GSC 3526:1995				
ROTSE1 J182427.29+453902.0	EW	18 24 27.3	+45 39 02	GSC 3526:2086 / GSC 3526:2112
GSC 3109:859				
ROTSE1 J183016.46+410508.5	EW	18 30 16.5	+41 05 08	SAO 47538 / GSC 3109:26
GSC 3526:2369				
ROTSE1 J183336.16+463545.1	EW	18 33 36.2	+46 35 45	GSC 3526:2751 / GSC 3527:1345

Ephemeris:

Star name	E 2400000+	P [day]	Source
ROTSE1 J182345.43+410547.6	52886.3866(2)	0.3687526	present paper
ROTSE1 J182427.29+453902.0	52886.5072(7)	0.292258	”
ROTSE1 J183016.46+410508.5	52886.3468(2)	0.468816	”
ROTSE1 J183336.16+463545.1	52926.3248(6)	0.330259	”

Times of minima:

Star name	Time of min. HJD 2400000+	Error	Type	Filter	$O-C$ [day]	Rem.
GSC3108:57 (Lyr)	51426.6763	6	s	none		ROTSE1
	51448.6174	4	p	none		ROTSE1
	52886.3874	16	p	none		
	52899.4771	10	s	none		
	52907.4058	17	p	none		
	52924.3685	11	p	none		
	52946.3086	12	s	none		
	52948.3374	7	p	none		
	52951.2865	3	p	none		
GSC3526:1995 (Lyr)	51426.6759	8	p	none		ROTSE1
	52886.3627	15	s	none		
	52886.510	4	p	none		
	52899.3647	23	p	none		
	52907.4029	10	s	none		
	52924.3575	22	s	none		
	52926.2568	21	p	none		
	52928.300	3	p	none		
	52946.2714	11	s	none		
	52948.3175	19	s	none		
	52951.2405	7	s	none		
GSC3109:859 (Lyr)	51288.8553	9	s	none		ROTSE1
	51332.6887	6	p	none		ROTSE1
	52886.3474	12	p	none		
	52899.4730	20	p	none		
	52924.3215	13	p	none		
	52928.3054	6	s	none		
	52946.3548	8	p	none		
	52948.2309	7	p	none		
	52951.2780	5	s	none		
GSC3526:2369 (Lyr)	51308.7196	14	p	none		ROTSE1
	51325.7244	14	s	none		ROTSE1
	52886.3638	8	p	none		
	52899.4109	24	s	none		
	52907.3374	5	s	none		
	52924.3430	11	p	none		
	52926.3258	11	p	none		
	52928.3073	12	p	none		
	52946.3040	13	s	none		
	52948.2845	8	s	none		
	52948.4519	15	p	none		
	52951.2573	12	s	none		

Explanation of the remarks in the table:

ROTSE1: Observations of Akerlof et al. (2000).

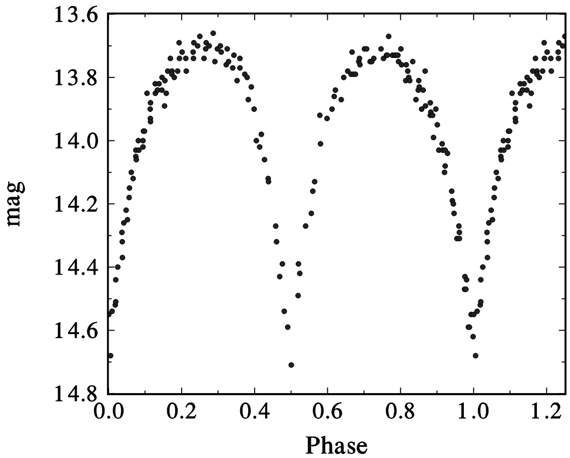

Figure 1. CCD light curve (without filter) of GSC 3108:57

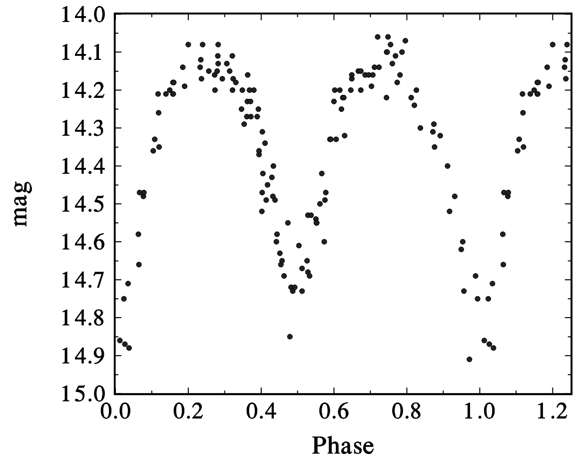

Figure 2. CCD light curve (without filter) of GSC 3526:1995

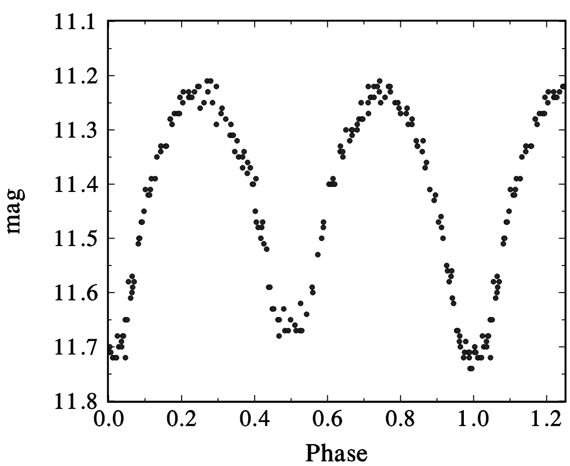

Figure 3. CCD light curve (without filter) of GSC 3109:859

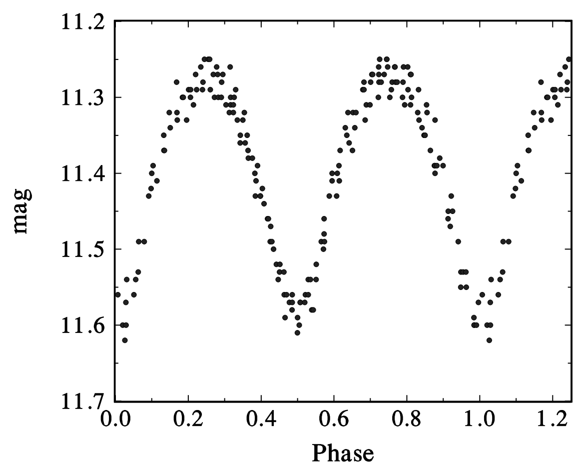

Figure 4. CCD light curve (without filter) of GSC 3526:2369

Remarks:

As a byproduct of the ROTSE1 CCD survey, a large number of new variables have been discovered (Akerlof et al., 2000). In a series of papers, we report unfiltered CCD observations for some of the close binary systems (type EW) in the list of Akerlof et al. (2000). This installment contains information on four variables in the constellation Lyra. The four stars were observed with our CCD equipment during several nights between JD 2452886 and JD 2452951. A total of 176 CCD frames were measured of GSC 3108:57, 145 frames of GSC 3526:1995, 193 frames of GSC 3109:859 as well as 197 frames of GSC 3526:2369. Figures 1 through 4 show our observations folded with the elements given in the Table of Ephemeris. These elements of variation are deduced from a linear fit to the normal minima from the ROTSE1 data and the timings of minimum derived from our data given in the table of Times of minima.

Availability of the data:

Upon request from diethelm@astro.unibas.ch

Acknowledgements:

This research made use of the SIMBAD data base, operated at CDS, Strasbourg, France

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FLICKERING AND PERIODIC ACTIVITY IN THE 2004 OUTBURST OF BZ UMa

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BZ UMa, α=08$^{\rm h}$53$^{\rm m}$44$^{\rm s}_{.}$14 δ=+57°48′41″.1 (J2000) (Downes et al., 2001), is a UG system (Kholopov et al., 1985) that has defied subclassification. Its orbital period, 0.0679 days, (Ringwald et al., 1994) and mass ratio, 0.20, (Jurcevic et al., 1994) suggests subclassification as a UGSU. Detection of superhumps in an outburst would be expected as well, but to date they have not been seen. It has also been suggested in literature that BZ UMa is a TOAD (Howell et al., 1995) and/or an intermediate polar (Kato, 1999).

BZ UMa was detected in outburst visually by Mike Simonsen on Feb 25.3, 2004. The AAVSO immediately began an intensive CCD campaign to observe BZ UMa (Price et al., 2004). Eleven AAVSO observers made 4,270 CCD observations over the course of four nights. Reduced data were reported to 0.01 magnitudes. The observations were combined into four datasets representing each night of observations and analyzed separately. A 2nd order polynomial fit was applied independently to the first, second and fourth night of observations before their data were combined in order to remove the long term fading trend and to remove zero-point differences from filtered and unfiltered observations.

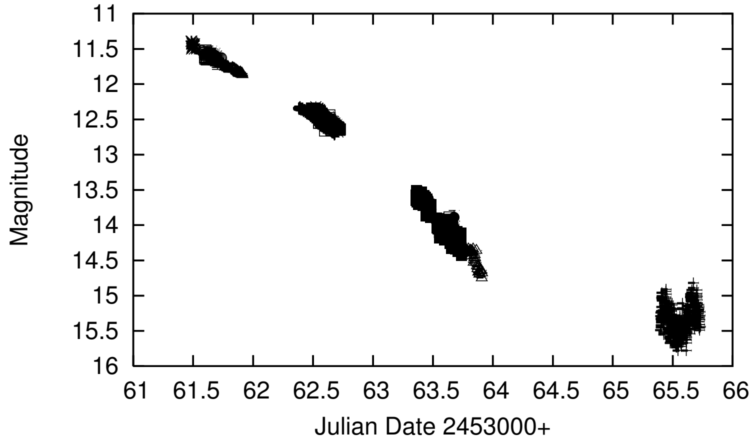

Figure 1. AAVSO BZ UMa 2004 Outburst CCD Light Curve

On the third night a 3rd degree fit was needed due to the rapid decline of BZ UMa at the time. All calibrated photometry was done by the individual observer and includes flat and dark frame application. Uncertainty was reported for each observation and is available with the entire data set upon request made to the AAVSO (`aavso@aavso.org`).

Johnson B and V field calibration was performed on multiple nights using the USNO-FS 1.0m telescope along with a large set of Landolt standards of wide color and airmass. A complete table of field stars, including complete BV data, is given in `5526-t1.txt`. The comparison chart used by the observers is given in Figure 1.

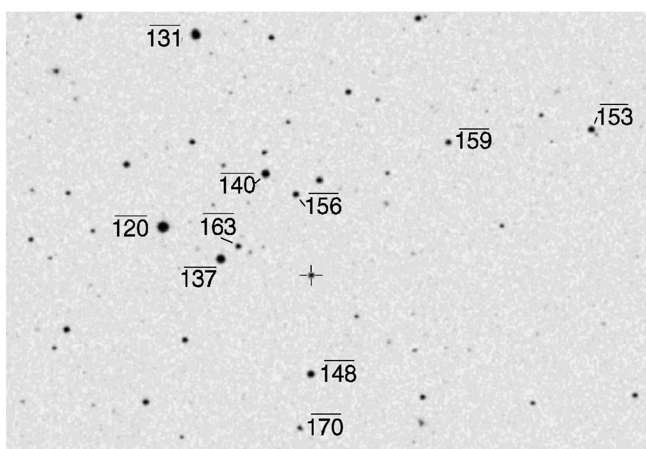

Figure 2. Comparison star chart ($8' \times 6'$, N is down, E is right) - BV data and errors are given in `5526-t1.txt`

Fourier and wavelet analysis (Foster, 1996) do not reveal the detection of superhumps or any coherent periodic activity until the fourth night when the orbital period appears. Fourier analysis with the CLEAN algorithm (Foster, 1995) results in a period of 0.068 $\pm$ 0.002 days in that fourth night of data. The power spectrum of the Fourier analysis reveals red noise (Fig. 3) which is associated with rapid flickering (Hellier, 2001) which is also seen in the light curve (Fig. 4). However, a hint of periodic activity is detected in the power spectrum for the third night (Fig. 5). A period of 0.030 ± 0.0004 days was determined during this episode which is similar to that reported in the 1999 outburst (Kato, 1999).

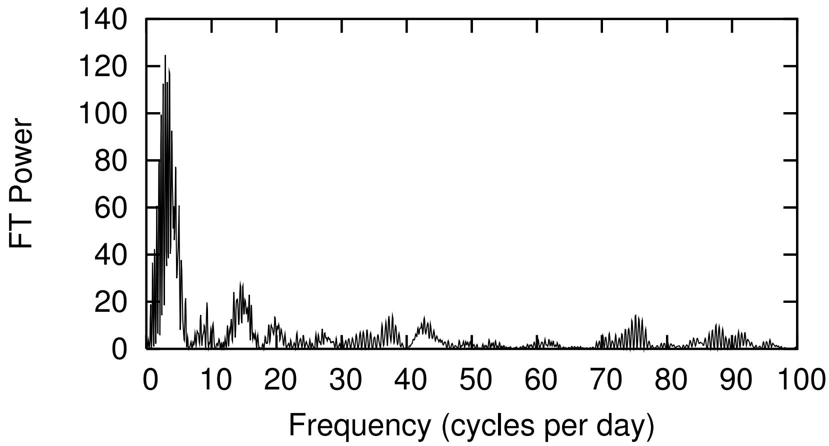

Figure 3. Evidence of low frequency flickering in power spectrum red noise from the first night (Feb. 25 - Feb. 26).

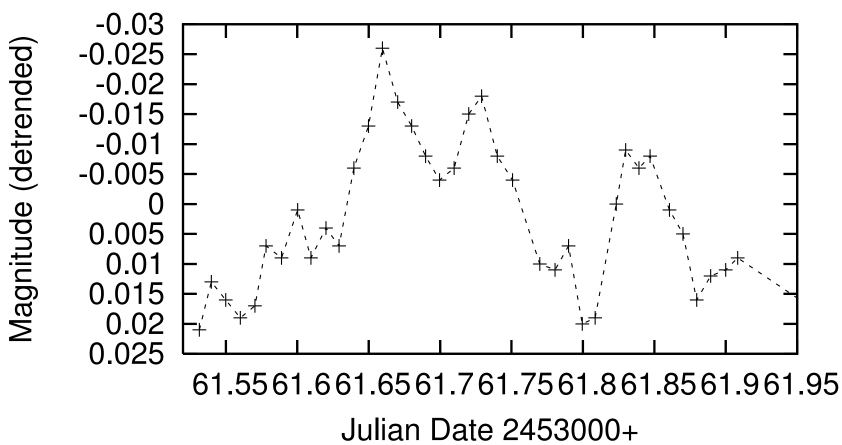

Figure 4. Evidence of flickering in light curve from the first night (Feb. 25 - Feb. 26). Data has been averaged into 0.01 day bins.

The AAVSO International Database has 10,820 observations of BZ UMa by 159 observers dating back to November 21, 1968. Analysis reveals 20 outbursts where BZ UMa was brighter than 14.5 visual magnitude and observed by more than one observer. A long period of inactivity occurred between 1976 and 1992 where only 1 outburst was detected and confirmed despite consistent monitoring. An average cycle of 312.6 days between outbursts was computed while omitting that gap. That would predict the next future outburst around January 3, 2005 ± 108.3 days using the standard deviation as error. High precision observations with good temporal resolution could help detect further periodicities and determine the nature of this enigmatic system.

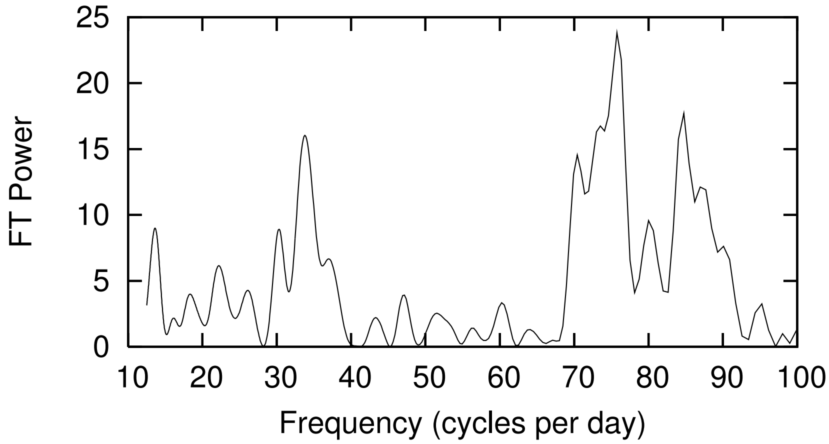

Figure 5. Periodicity around 33 cycles per day in power spectrum for the third night (Feb. 28 - Feb. 29).

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V802 AQUILAE: A DWARF AW UMa-TYPE BINARY SYSTEM

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In a recent IBVS note, Van Cauteren's (2001) presented crucial, but unfiltered light curves of V802 Aql [GSC 5119 948, $\alpha(2000) = 18^{\rm h}58^{\rm m}54\overset{\rm s}{.}8$, $\delta(2000) = -03°01'11\overset{''}{.}5$]. They show a shallow eclipse curve with an amplitude of only 0.35 mags, yet there was a total eclipse of long duration (0.1 phases). These characteristics reveal an extreme mass ratio system in a state of over contact like AW UMa and V902 Sgr. Such binaries may be in their final phases of coalescence into a single FK Comae/Blue Straggler-type stars. Also V802 Aql has a period of only $0\overset{\rm d}{.}2677$, making it the smallest of this rare group of binaries. Consequently, we included it as an important target on our observing run at CTIO in Chili. Our B,V,R,I light curves were taken at using a 0.9-m reflector with the CFIM T2K CCD camera (quad mode) and standard $UBVR_cI_c$ filters. The observations were taken by RGS and DRF on 6,7 and 9 June 2002; 130 in B, 160 in V, 147 in Rc, and 148 in Ic in the Johnson-Cousins system.

The stars GSC 5119 964 ($\alpha(2000) = 18^{\rm h}58^{\rm m}55\overset{\rm s}{.}0$, $\delta(2000) = -03°02'52''$) and GSC 5119 358 ($\alpha(2000) = 18^{\rm h}58^{\rm m}45\overset{\rm s}{.}9$, $\delta(2000) = -03°04'25''$) were used as comparison and check stars, respectively. A finding chart of V802 Aql (V), the comparison (C) and check star (K) are given in Figure 1. The light curves and color curves of the variable are given in Figure 2 as normalized flux versus phase. In addition to the characteristics mentioned above, our curves display a depressed primary maxima, (0.06 mag in B), suggesting the presence of heavy spot activity which would drive the coalescence via magnetic breaking.

Three mean epochs of minimum light were determined from U,B,V,R,I eclipse timing using parabola fits:

$$\begin{aligned} \text{HJD MIN I} &= 2452432.7562 \pm 0.0002 \\ \text{HJD MIN II} &= 2452431.8216 \pm 0.00081 \\ &= 2452434.8976 \pm 0.0011 \end{aligned}$$

We calculated the following linear ephemeris from our observations:

$$\text{HJD Tmin I} = 2452432.7571(2) + 0.267532 \pm 0.000042 \text{ d} \times \text{E}, \tag{1}$$

A linear fit to all available timings of minimum light gave:

$$\text{HJD Tmin I} = 2452432.7570(4) + 0.26769479 \pm 0.00000011 \text{ d} \times \text{E} \tag{2}$$

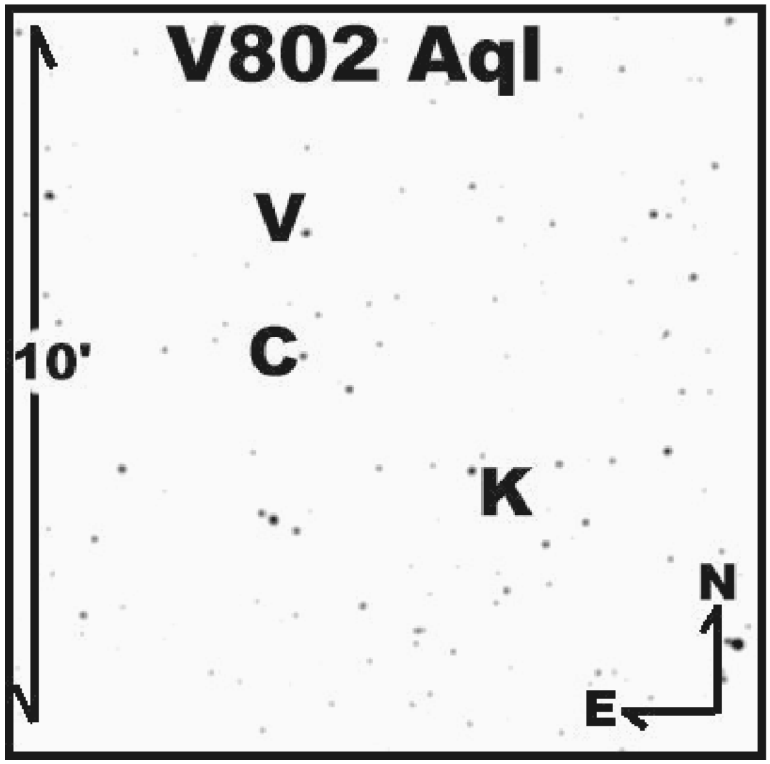

Figure 1.

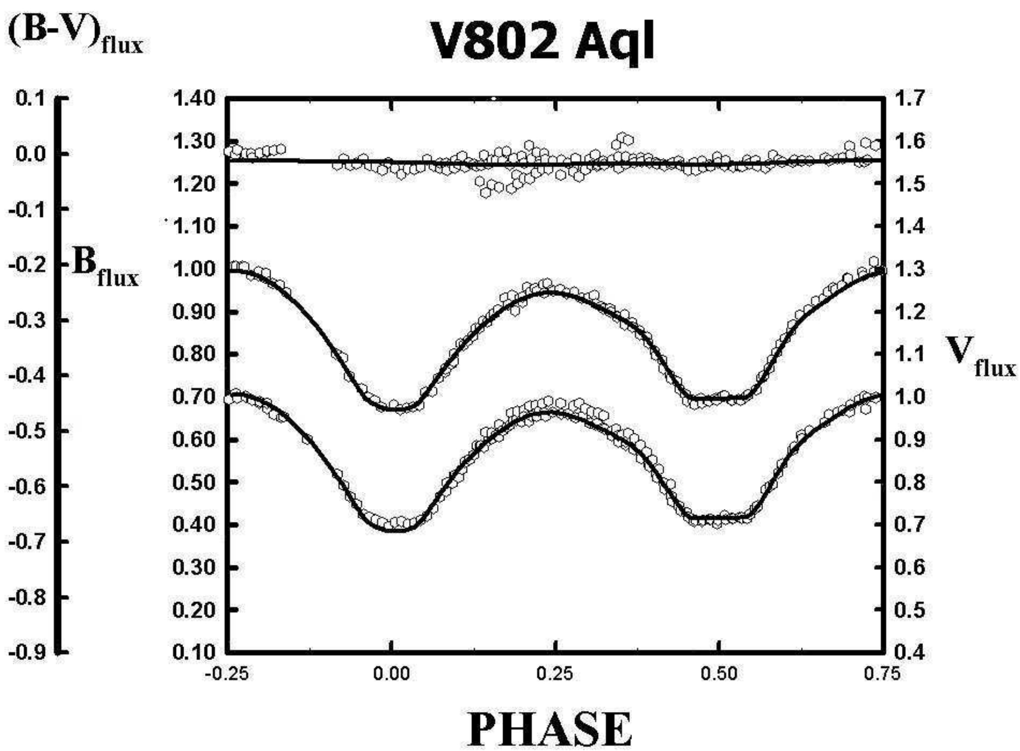

Figure 2.

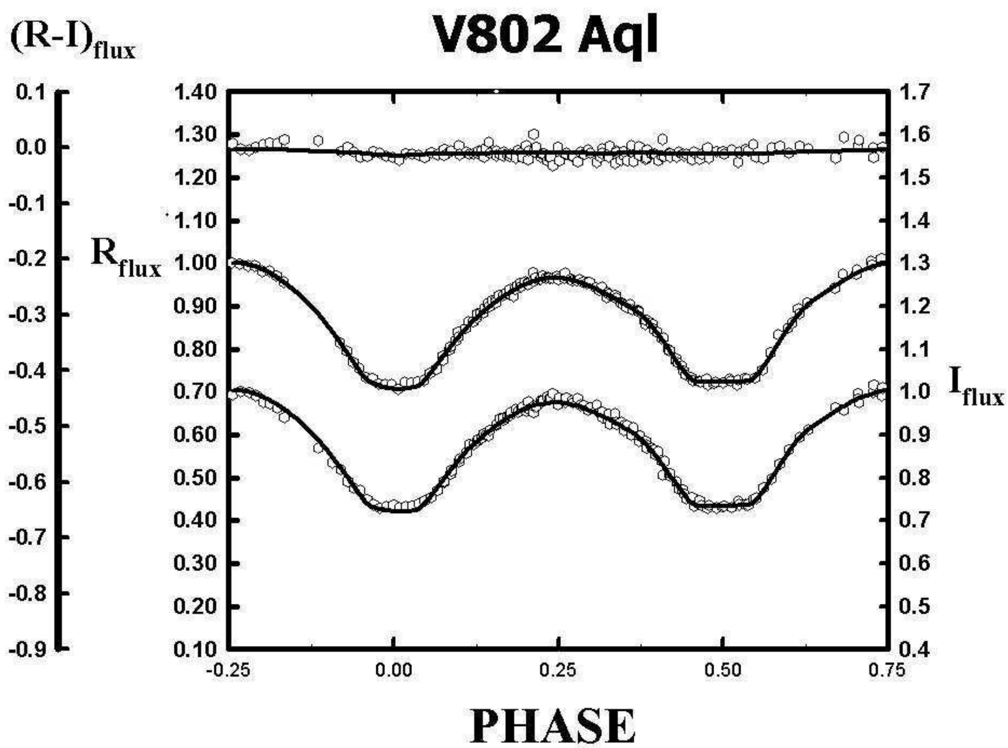

Figure 3.

Equation 1. is not consistent with Equation 2. and may indicate that the period is decreasing. This is the expected scenario, since the period should decrease as the mass ratio becomes more extreme.

Photometric spectral types have been determined from standard star observations on the June 9 2002. V802 Aql is of K0 to K2V type, its comparison star is G8 to G9V type ($V = 12.645 \pm 0.008$, $B - V = 0.762 \pm 0.006$) and the check star is G9 to K2V type ($V = 13.418 \pm 0.006$, $B - V = 0.842 \pm 0.007$). The V and $B - V$ magnitudes for the variable was 12.547±0.003 and 0.810±0.004 at phase 0.25 and 12.860±0.004, and 0.827±0.004 at phase 0.5, respectively. From this we fixed the surface temperature of the more massive component in light curve synthesis to be 5000 K.

Our preliminary Binary Maker 2.0 (Bradstreet, 1992) fits gave a mass ratio of 0.16. The results of the modeling provided input parameters for a complete simultaneous 5 color synthetic light curve solutions with the Wilson Code (Wilson & Devinney, 1971; Wilson, 1990, 1994). Our curves have not been transformed to the standard system but experience has shown that this introduces only minor changes in the models. Our results include a secondary temperature of 5120 K making the system, surprisingly, of W-type. The Roche-lobe fill-out was 30% and the mass ratio was 0.1608 ± 0.0002. The spotted region had a colatitude of 67°, a longitude of 281°, a spot radius of 20° and a temperature factor of 0.918. The spot was modelled on the more massive component. Our solution is shown overlaying the data in Figure 1. A geometrical representation of V802 Aql is given in Figure 3.

We would expect that the period is undergoing a constant decrease and the mass ratio is becoming more extreme. Plate archival searches and future monitoring of this system are needed to confirm the behavior of the system's orbital period.

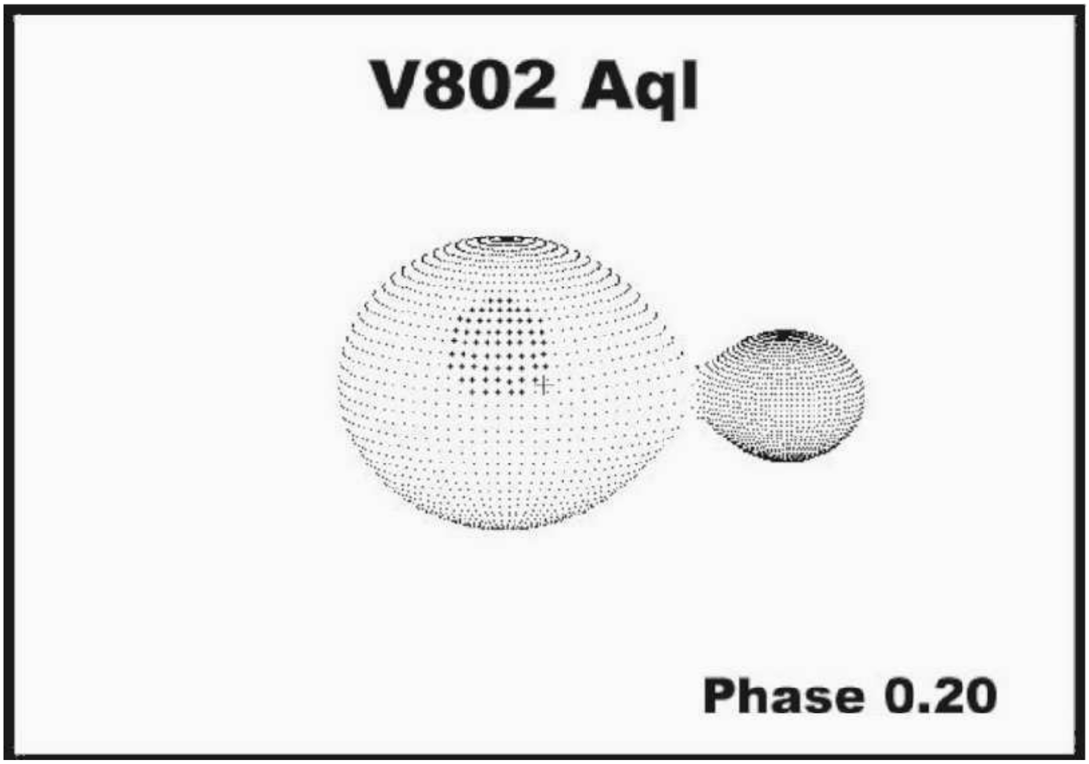

Figure 4.

We wish to thank CTIO for their allocation of observing time, and a small research grant from the American Astronomical Society which supported this run.

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FIRST SPECTRUM OF NSV 19451 – THE WRONG STAR?

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The star NSV 19451 has been found to be variable by Kolrvatykh (1983) while observing stars in the Hydra–Centaurus region and especially the Mira Cet type variable EW Hya. He found that EW Hya did not show high enough variations ($14^{\rm m}-16^{\rm m}$ pg, $P = 250^{\rm d}$), and thus considered its classification doubtful. Instead, in its vicinity, he found the variable star who later got the designation NSV 19451. This star varied around 1 mag between $V = 16\overset{\rm m}{.}2$ and $17^{\rm m}$ and is as such listed in the catalogue by Kazarovets et al. (1998) with the probable classification as a cataclysmic variable of U Gem subtype. It has thus been included into the atlas of Downes et al. (2001) who also provide a finding chart of the object.

Recently, NSV 19451 has been observed by Berto Monard (vsnet–alert 8120) who also listed the occurrences of the object in various catalogues. Taking also these listed values into account, he found the object to be a 'reasonably constant white–blue star around $V = 14\overset{\rm m}{.}4$'. He suspected the object to show emission lines indicating the cataclysmic variable nature, and concluded that the quoted magnitude range in the atlas of Downes et al. (2001) seems to be incorrect. Note that the atlas, as living edition, has been updated immediately and the magnitude range now includes Monards measurements as well.

To check the classification of NSV 19451 as cataclysmic variable and especially as U Gem type star, we performed spectroscopic observations using the ESO Faint Object Spectrograph and Camera (EFOSC2) at the 3.6 m telescope on la Silla, Chile. Two spectra, each of 10 min exposure time, have been obtained on 2004-05-01 at UT 02:25 using grism #6 and a $1''$ slit.

Standard reduction has been performed with IRAF. The BIAS has been subtracted and the data have been divided by a flat field, which was normalised by fitting Chebyshev functions of high order to remove the detector specific spectral response. The two spectra have been combined and then optimally extracted (Horne, 1986). Wavelength calibration yielded a final FWHM resolution 1.2 nm and a spectral range of 390 nm to 790 nm. The spectrum has been corrected for the instrument function and was flux–calibrated using the spectrophotometric standard LTT 3218. However, as the night was not of photometric condition, the absolute flux–values have to be regarded with caution.

The resulting spectrum is plotted in Fig. 1. It is dominated by absorption lines, mainly the Balmer series, Ca I and II, Na I, and the strong G–band at 430 nm. We have used the catalogues of Pickles (1985) and Silva & Cornell (1992) for classification and find the object to match a medium/late G–type dwarf. The best fitting template spectrum, of G6–8V type by Silva & Cornell has been over–plotted for comparison. We have found no signal of any emission lines or any other spectral feature which might indicate that

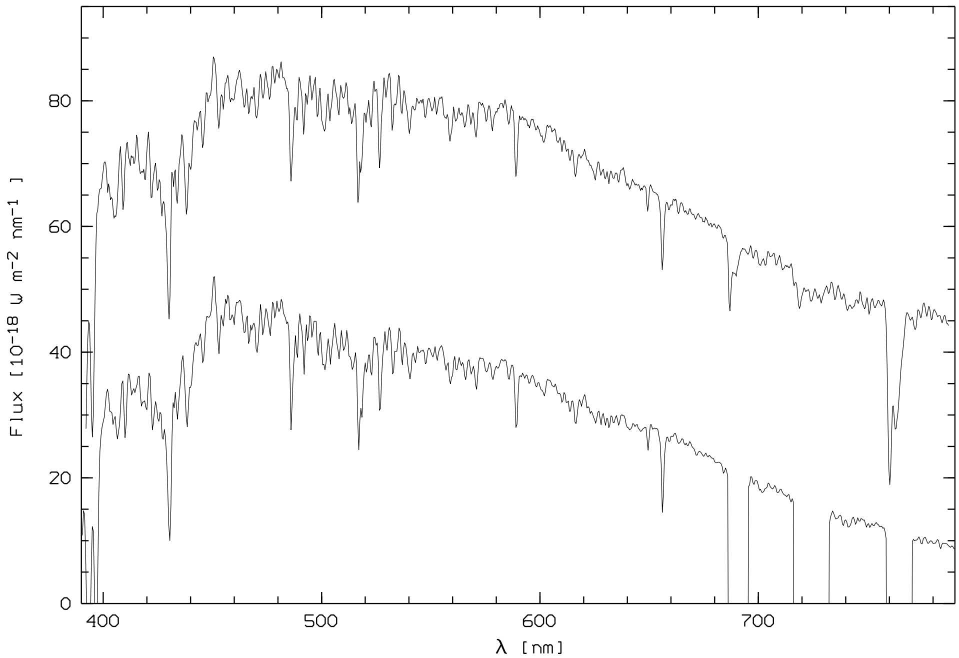

Figure 1. The optical spectrum of NSV 19451 (upper plot) and the best fitting template spectrum, a G6–8 type main sequence star (Silva & Cornell, 1992). Scaled to the same average flux value and arbitrary shifted down for purpose of clarity.

NSV 19451 is a cataclysmic variable. Instead, it seems to be a perfectly normal G–type star and most probably is not variable at all.

This conclusion is in perfect agreement with the findings of Monard that NSV 19451 does not show any light variations. However, Kolrvatykh (1983) observed its variability. So either, the object has been variable in the past but is behaving like a constant G–type star now, or the variable star observed by Kolrvatykh and listed as NSV 19451 by Kazarovets et al (1998) and the G–type star which is believed to be NSV 19451 are not the same object.

We rather believe the latter conclusion to be the case. For once, there is no variable type known which in outburst ($V = 14^{\rm m}$ now instead of 16–$17^{\rm m}$ before) resembles a G–type dwarf. On the other hand, the finding chart given by Downes et al. (2001) is done via coordinate match only and there are several fainter stars in the vicinity of the labelled object who might be the real candidate for Kolrvatykh's variable star. In fact, as Kolrvatykh does not give any coordinates nor uncertainties of the star he has observed but just states that it is in the vicinity of EW Hya, it is rather difficult to judge the ambiguity in the finding chart.

Time resolved photometry on all stars in the vicinity of the proposed position should help to clarify this issue and to recover the true variable NSV 19451 and maybe even the ambiguous Mira–star EW Hya.

Acknowledgement: We are grateful to Valentin Ivanov for his translation of Kolrvatykh's publication from Russian.

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THE NATURE OF THE ECLIPSING BINARIES SS Hya AND VW Cet

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SS Hya and VW Cet are long-neglected eclipsing binaries that have had suspicions raised about their variability. All the available photometry has been reviewed and additional measurements have been made recently of both stars by West using a 0.2-m f/6.3 Schmidt Cassegrain telescope with ST8 and ST9E CCD cameras, and a V filter.

SS Hya ($13^{\rm h}30^{\rm m}29\overset{\rm s}{.}51$ $-23^\circ38'58\overset{''}{.}2$) is bright, V = $7\overset{\rm m}{.}9$ with a spectral type of A0 V (Houk & Smith-Moore, 1988) and is listed in the GCVS (Kholopov et al., 1998) as an EA: system on the basis of over 900 photographic observations by Gaposchkin (1950), but no period is known. Gaposchkin found a range of 8.10 to 8.30: pg, which is probably barely larger than for constant stars, but made the comment, 'eclipsing?'. The star has a long history of suspected variability and was included in variable star catalogues long ago. The discoverer, Bemporad (1911) found variations between $7\overset{\rm m}{.}4$ and $8\overset{\rm m}{.}1$ from his visual observations of 1908–1911 and derived the elements $JD_{Max} = 2419207.4 + 8\overset{\rm d}{.}20 \times E$, with $M - m = 3$d. Despite the brightness of the star there is very little modern photometry. A small number of new measurements reported here give $V = 7\overset{\rm m}{.}89 \pm 0\overset{\rm m}{.}04$, which is generally consistent with the uncertainties. Cousins & Lagerwey (1970) made four measurements and derived mean values of, $V = 7\overset{\rm m}{.}88, (B-V) = 0\overset{\rm m}{.}00, (U-B) = -0\overset{\rm m}{.}06$, with the comment, 'Variable', and although there is no indication of range, this comment does need to be considered seriously.

Data are also available from Hipparcos and ASAS3. The Hipparcos data are effectively constant at $Hp = 7.907 \pm 0.018$, with two apparently discordant points 0.05 and 0.1 mag fainter than the rest. A Discrete Fourier Transform periodogram (DFT) of all the Hipparcos data shows no periodic variation greater than 0.015 mag for frequencies up to 10 cycle day^{-1}, and without these two points the limit becomes 0.010 mag.

SS Hya is very close to the saturation limit for the ASAS3 instrument and prior to a detector change at $JD = 2452200$ was in fact above it, which sometimes produced spurious variations of up to 0.9 mag. The measurements of SS Hya after this date, and with errors < 0.03 mag, are effectively constant at $V = 7\overset{\rm m}{.}896 \pm 0\overset{\rm m}{.}011$. There are a few discordant points, up to 0.05 mag adrift, but the DFT periodogram shows no periodic variation greater than 0.006 mag for frequencies up to 10 cycle day^{-1}.

In summary the photometry suggests that SS Hya is not an obvious variable; at most the full amplitude must be < 0.03, which is well below the range of photographic or

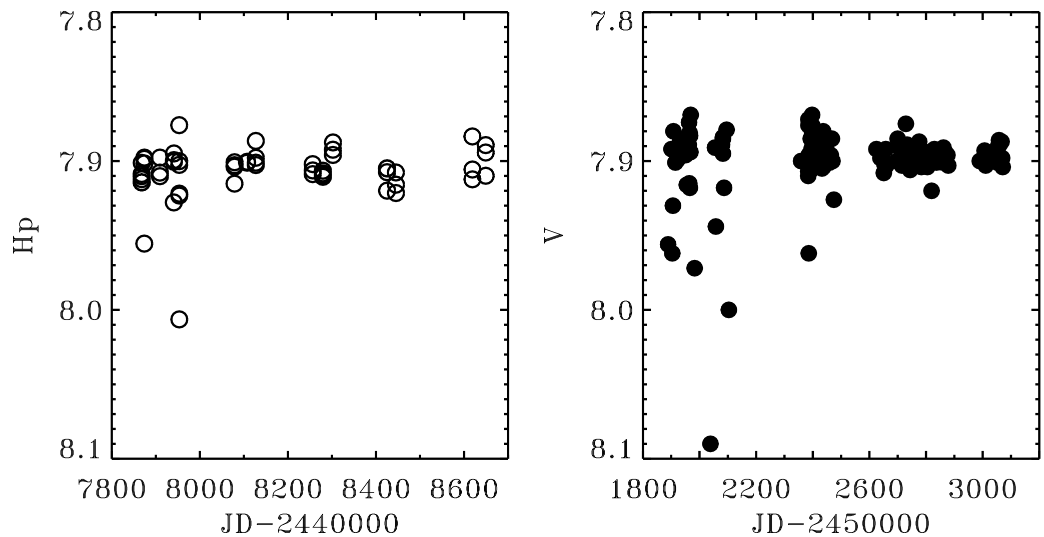

Figure 1. The light curve of SS Hya from the Hipparcos data (left) and the ASAS3 data (right). All the ASAS3 data prior to $JD = 2452200$ are suspect due to saturation problems and many of the fainter points lie off the plot.

visual detection. The only remaining doubt about its lack of variation is the comment by Cousins & Lagerwey, otherwise there would be no suggestion that it was variable at all.

Adams et al. (1924) give two radial velocities, apparently for two components, of -98 and $+117$ km s^{-1} with the comment, 'Double lines. Doubtless *Algol* type'. If it is an Algol system then the secondary is sufficiently bright to be seen spectroscopically. In contrast, the General Catalogue of Stellar Radial Velocities (Wilson, 1953) gives a mean velocity of $+10$ km s^{-1} with the poorest quality flag (E), based on just two measurements. If the large velocity variation and double lines are correct then the system must contain stars with similar luminosities and not too dissimilar masses. If the components are both approximately A0 V then a period, $0.5 < P < 2$ days is required to generate the velocity range, depending on the inclination. As there are no obvious eclipses the longer periods are physically impossible, and with $P \sim 1$ day an inclination, $i < 40$ is required to avoid eclipses, which is not unrealistic. If it is an Algol system then everything depends on the mass ratio, but both stars will still have broadly similar sizes and the inclination requirement will remain approximately the same. It therefore seems possible that SS Hya is a low-inclination binary, possibly showing very low-amplitude ellipsoidal or grazing eclipse variations.

The Hipparcos parallax of SS Hya is 5.80 ± 1.07 mas which leads to 1-σ absolute magnitude of, $1^{\mathrm{m}}\!\!.25 < M_V < 2^{\mathrm{m}}\!\!.06$. Interstellar extinction should be small as at < 200 pc the star is only just beyond the local bubble (Sfeir et al., 1999). A ZAMS A0 V star is expected to have $M_V = 1.5$, and more general values are up to a magnitude brighter, which leaves little leeway for an additional component. A significantly less luminous secondary might be accommodated, but unless the parallax is badly in error, two stars of similar luminosity are not possible.

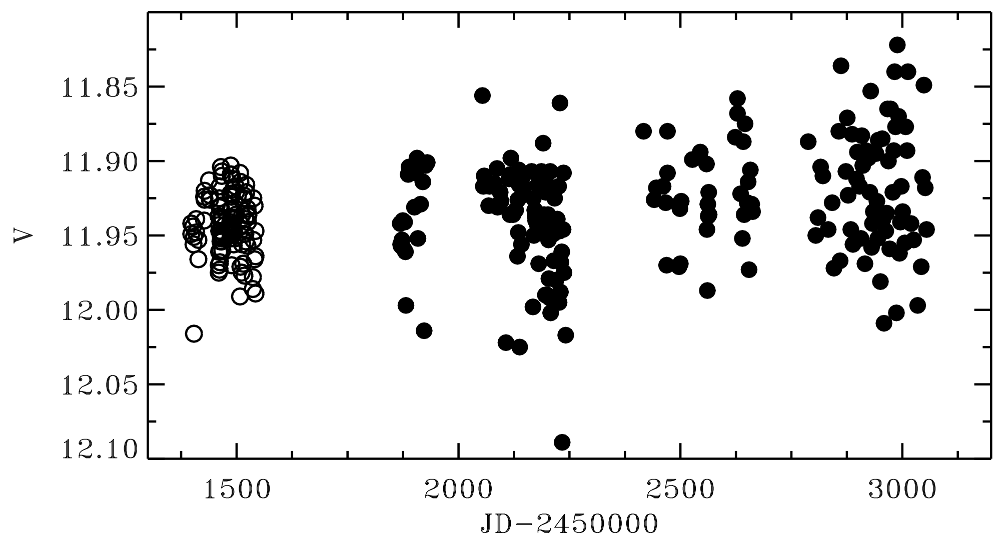

Figure 2. The light curve of VW Cet showing the unfiltered ROTSE data (open circles) and the ASAS3 V data (filled circles).

VW Cet ($01^h39^m04\overset{s}{.}31$ $-17°50'48\overset{''}{.}4$) is listed in the GCVS (Kholopov et al., 1998) as a short-period eclipsing binary of uncertain type, EB/KW:. It was discovered by Petit (1953) who reported a short-period eclipsing variable of β Lyrae or W UMa type with a visual range of $11\overset{m}{.}6$ to $12\overset{m}{.}1$. These variations were apparently confirmed by 35 observations by Oskanjan (1953), with a visual range of 11.6 to 12.2, and a period about 0.24 days. Finally, Petit (1956) derived the published ephemeris $JD_{Min} = 2435111.396 + 0.486 \times E$ based upon 110 visual estimates. There have been no further measurements until very recently.

Our new observations of VW Cet have been obtained serendipitously since 2001 during a programme to monitor UV Cet, which lies close by. These 96 observations have $V = 11\overset{m}{.}979 \pm 0\overset{m}{.}064$, which is broadly consistent with the uncertainties, but they show no suggestion of a 0.486 day variation. A DFT periodogram of these data is essentially noise with no periodic variation greater than 0.025 mag for frequencies up to 10 cycle day^{-1}.

VW Cet has also been observed by ASAS3 and ROTSE. Limiting the ASAS3 data to those with errors < 0.03 mag and ignoring one discordant point (leaving 197 points), gives $V = 11\overset{m}{.}930 \pm 0\overset{m}{.}039$. A DFT periodogram of these data shows no periodic variation greater than 0.021 mag for frequencies up to 10 cycle day^{-1}. Similarly, restricting the ROTSE-1 data to those with errors < 0.03 mag (115 points) gives $M_{ROTSE} = 11\overset{m}{.}943 \pm 0\overset{m}{.}020$, and the maximum periodic variation from the DFT periodogram is 0.011 mag. A very similar limit is also found for the combined ASAS3 and ROTSE data sets.

In summary there is no evidence for the 0.486 day period for VW Cet and there is no reason to believe there is any periodic variation at all. The total extinction in this direction from the NASA/IPAC Extragalactic Database is very low, $A_V = 0\overset{m}{.}06$ so the 2MASS colours $J - H = 0\overset{m}{.}46(3)$ and $H - K = 0\overset{m}{.}08(3)$ should be very close to intrinsic, and suggest that VW Cet has a spectral type close to K0. It has a small but significant proper motion so it is most likely a field dwarf.

West's photometry of SS Hya and VW Cet is available through the IBVS website as `5529-t1.txt` and `5529-t2.txt` respectively.

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IMPROVED ORBITAL EPHEMERIS OF GT URSAE MAJORIS

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GT UMa (= HIP 51876, $\alpha_{2000} = 10^{\rm h}35^{\rm m}55\overset{\rm s}{.}7$, $\delta_{2000} = +63^\circ35'32''$) is an eclipsing binary with an orbital period of 1.16472 days as quoted in the Hipparcos Catalogue Variability Annex. The star has no other photometric monitoring reported in the literature. So we embarked on a thorough photometric study conducted at the Črni Vrh observatory, Slovenia in the observing seasons of 2002 and 2003. The results show that the orbital period needs to be improved.

We obtained 3713 pairs of Johnson B and V photometric measurements of GT UMa during 17 useful nights between 2002 Jan 3 and 2003 Jan 29. The observations were obtained with a 19-cm, f/4 flat field S-C telescope and Wright Instruments Peltier cooled system with an EEV CCD02-06-1-206 backside illuminated CCD with 574×385 pixels of 22 μm each. Exposure time was 30 sec in B and 15 sec in V band. Measurements have been reduced by the `DAOPHOT` (Stetson, 1987) package based on 4 comparison stars with colour coefficients calculated each night. Table 1 quotes names, magnitudes and standard deviations of comparison stars. All comparison stars are from the Tycho II catalogue with their Johnson magnitudes calculated from the Tycho ones using the relations $V = V_T - 0.090(B_T - V_T)$, $B - V = 0.850(B_T - V_T)$ (ESA, 1997). We can infer that median error of individual measurements of GT UMa is 0.015 in V and 0.011 in B band. This is in agreement with the dispersion of the light curve of GT UMa measured outside of photometric eclipses.

The determination of eclipse minima has been done with the algorithm proposed by Kwee & Van Woerden (1956); the results are presented in Table 2. We also report some minima from Hipparcos $\rm H_p$ measurements. Their accuracy is lower because of the substantially smaller number of points and because individual points are separated by at least one rotational period of the satellite.

The original ephemeris based on Hipparcos data

$$\mathrm{HJD_{min}} = 2448500.22 + 1.16472\mathrm{E} \tag{1}$$

is not consistent with our observations, as timings of our minima are displaced for $\sim$ 0.05 days. A new ephemeris consistent with the whole body of Hipparcos and our measurements is:

$$\mathrm{HJD_{min}} = 2452278.522(2) + 1.164708(2)\mathrm{E} \tag{2}$$

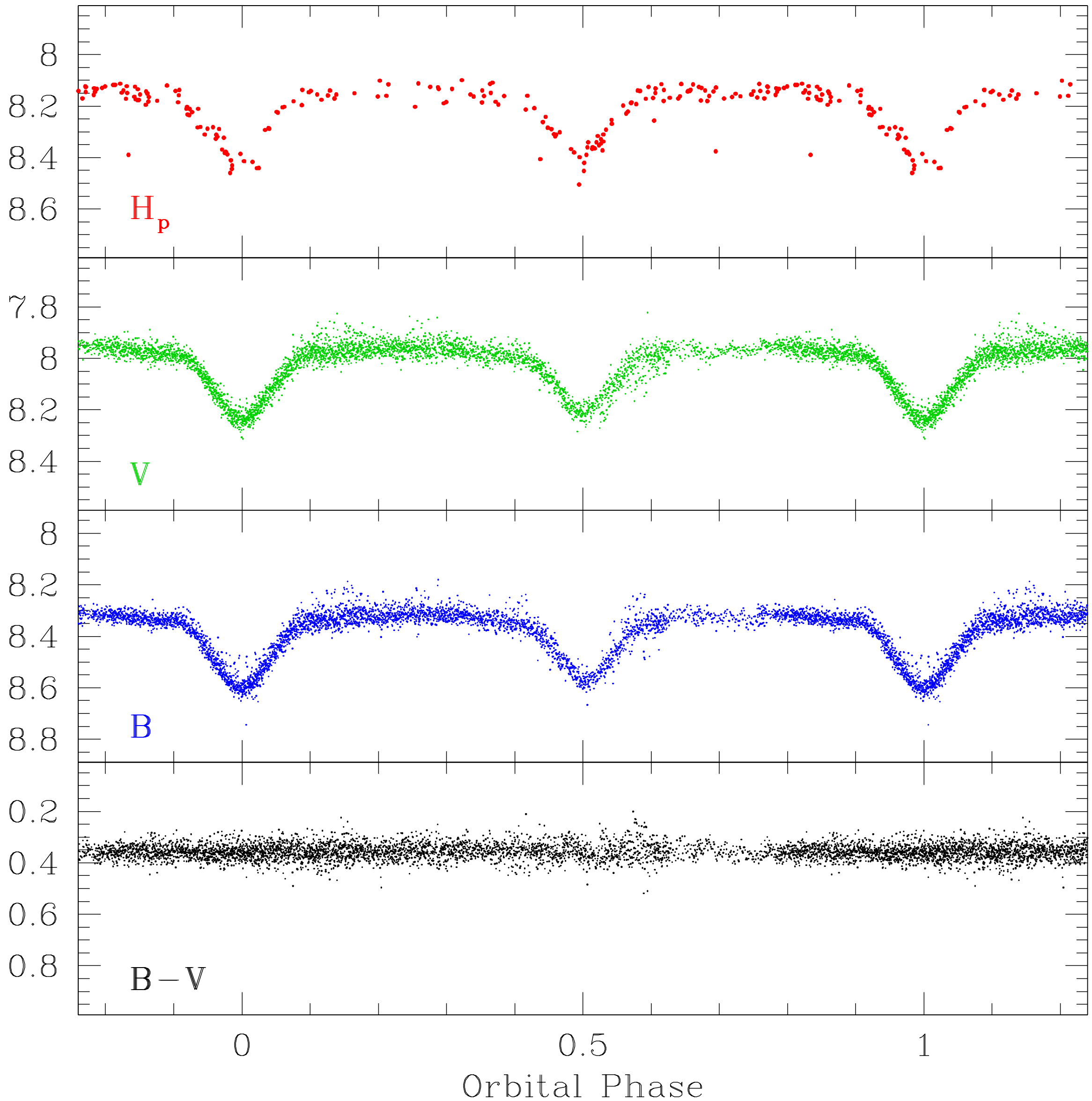

Figure 1. Hipparcos and our photometry with orbital phase calculated from improved orbital ephemeris (eq. 2).

Table 1: Comparison stars, average magnitudes and typical errors of individual measurements. Each star was measured on 3931 (V) or 3934 (B) frames.

star	B	V	B-V	σ(B)	σ(V)
TYC 4147 164 1	10.755	10.326	0.429	0.021	0.036
TYC 4147 600 1	11.774	11.031	0.743	0.027	0.030
TYC 4147 267 1	11.764	10.978	0.786	0.035	0.067
TYC 4147 646 1	11.637	11.051	0.586	0.050	0.080

Table 2: Times of eclipse minima from Hipparcos and our data.

type	HJD	error	filter
primary	2448474.60	0.02	H_p
primary	2448738.97	0.02	H_p
secondary	2449003.92	0.02	H_p
primary	2452278.52	0.005	B and V
primary	2452279.69	0.008	B and V
secondary	2452282.60	0.005	B and V
primary	2452285.51	0.005	B and V
secondary	2452287.255	0.006	B and V
primary	2452652.396	0.004	B and V
primary	2452654.72	0.008	B and V

Numbers in brackets give errors on the last decimal place. This ephemeris is used for the photometry plot (Fig. 1). Clearly the improved orbital period satisfactorily joins photometric observations by Hipparcos and our new photometry. Note that it does not require any secular change of orbital period during the time spanned by Hipparcos and our observations.

The light curves are flat-topped with partial eclipses centered on 0.0 and 0.5 in orbital phase. This indicates that GT UMa is a detached binary and that photometric data are consistent with a circular orbit. The constancy of the B-V index during eclipses indicates that the two stars have an equal temperature. The average value of B-V = $0\overset{m}{.}36$ corresponds to the spectral type F2 on the main sequence which agrees with the spectral type from the literature.

Hipparcos recognizes GT UMa as a visual binary with another component at a separation of 17.570 arcsec, position angle $266\overset{\circ}{.}4$, and with the same parallax (8.18 mas). The companion star is $\sim$ 2.6-mags fainter than the eclipsing binary and of a late F or an early G spectral type. The separation of the components is smaller than the width of the Hipparcos star mapper slits (34 arcsec), so light from the visual companion could slightly contaminate the measured Tycho magnitudes of the eclipsing binary. Halbwachs et al. (1997, their Figure 1) showed that this effect is smaller than 0.02 mags for the V_T filter. Since the eclipses were sampled at random orientations of the star mapper slit, the influence on the derived relative depth of the eclipses is much smaller, in our case below the statistical error of individual H_p measurements. Visual binary is wide enough that it has no influence on the results of our CCD photometry. We note that components of the GT UMa visual binary have a very different size and direction of their proper motion. The implied relative velocity projected on the plane of the sky is $\gtrsim$ 200 km s^{-1}. At a projected separation of 2150 a.u. this implies that GT UMa's visual binary is clearly not a bound system, so it can have no influence on timing of eclipses and so on orbital ephemeris of the eclipsing pair.

We note that a faint ROSAT X-ray source 1RXS J103554.9+633533 (Voges et al., 2000) lies very close to the GT UMa visual binary. At the time of ROSAT observations (21-24 Oct 1990) the component A (i.e. the eclipsing binary) of GT UMa was only 5 arcsec and the component B only 13 arcsec from the reported position of the X-ray source. But we note that the positional error for ~ 15 photons detected by ROSAT is 16 arcsec, so the X-ray source may correspond to either of the two components or to a completely unrelated source. A relatively small proper motion of the A component of GT UMa will keep it within the ROSAT positional errorbox for the foreseeable future, so the best chance to resolve the issue is a repeated X-ray imaging with superior angular resolution capabilities aboard the Chandra satellite.

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DISCOVERY OF A δ SCUTI STAR IN V469 Cyg

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V469 Cygni was first identified as a variable star by Wachmann (1940), with a light curve and ephemeris elements published later (Wachmann, 1948). The system was also apparently independently discovered to be an eclipsing binary by Whitney (1947). We added V469 Cygni to our ongoing program of monitoring eccentric orbit, apsidal motion and other systems for period changes based on its appearance on a list of apsidal systems published by Hegedüs (1988). This system was observed at Appalachian State University's Dark Sky Observatory, using the 0.80-m telescope equipped with a Photometrics (now Roper) CH200 CCD camera with a Tek 1024^2 chip and Bessel filter set. Observations obtained of secondary eclipse on the night of UT 12 July, 2003 showed light variations characteristic of δ Scuti behavior. A recent compilation of δ Scuti stars by Rodríguez et al. (2000) lists 86 stars that are members of multiple systems, with only nine found in eclipsing binaries (Rodríguez and Breger, 2001). V469 Cyg now appears to be an additional system. We note that a search for δ Scuti stars in binary systems is under way by Szekely (2003). The data were reduced using Mira AP software.[†] The instrumental light curves for the observed secondary, in the B,V and R filters are shown in Figure 1.

The pulsations have a period of about 40 minutes and a total amplitude of about 0.02 magnitudes. A primary eclipse was observed on UT 24 August, 2003 (Figure 2). While the pulsations are visible across secondary, their amplitude appears to drop greatly in primary, possibly indicating that the δ Scuti star is the hotter of the pair of stars. However, the pulsation may simply not be visible due to the steeper scale of the primary eclipse.

We had in fact already observed a primary eclipse (in the V filter, only) in 1997 but had not noticed the variations due to the scale of the eclipse and because we had little outside eclipse coverage. We have also obtained other eclipses, for a total of five. The times of minimum light for the five events are given in Table 1.

Our times of minimum and their standard errors were calculated using the method of Kwee & van Woerden (1956), using an algorithm by Ghedini (1982). The times for each filter are listed individually since some do not overlap by their formal errors. This appears to be due to differences of the pulsation amplitude with color. The pulsation contribution makes it difficult to get an accurate time of minimum light. In the case of JD 2452876, clouds interrupted the observations briefly, with more V images having been randomly

[†]The Mira AP software is produced by Axiom Research Inc.

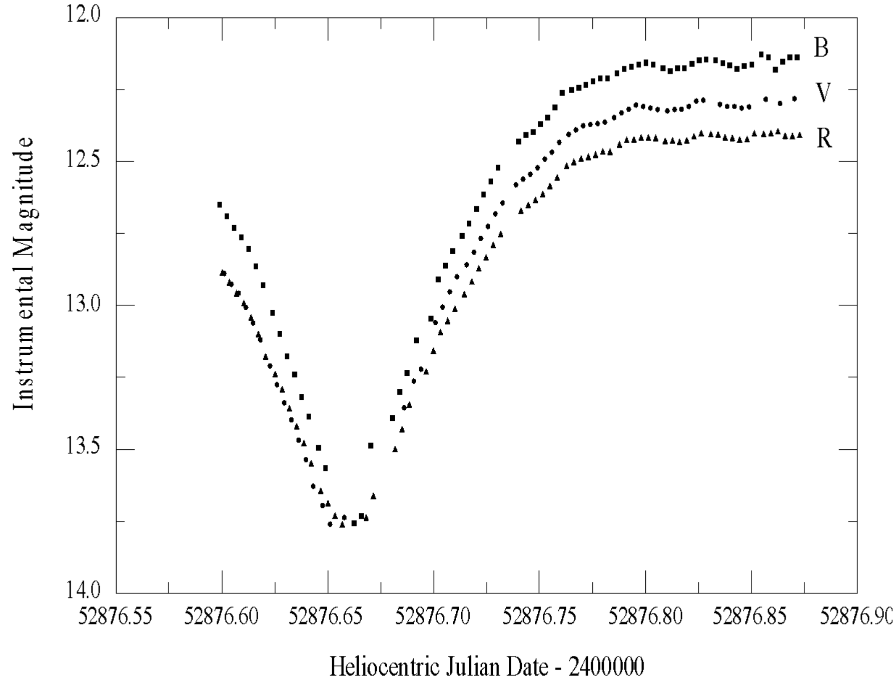

Figure 1. Secondary eclipse of V469 Cyg on the night of UT 12 July 2003.

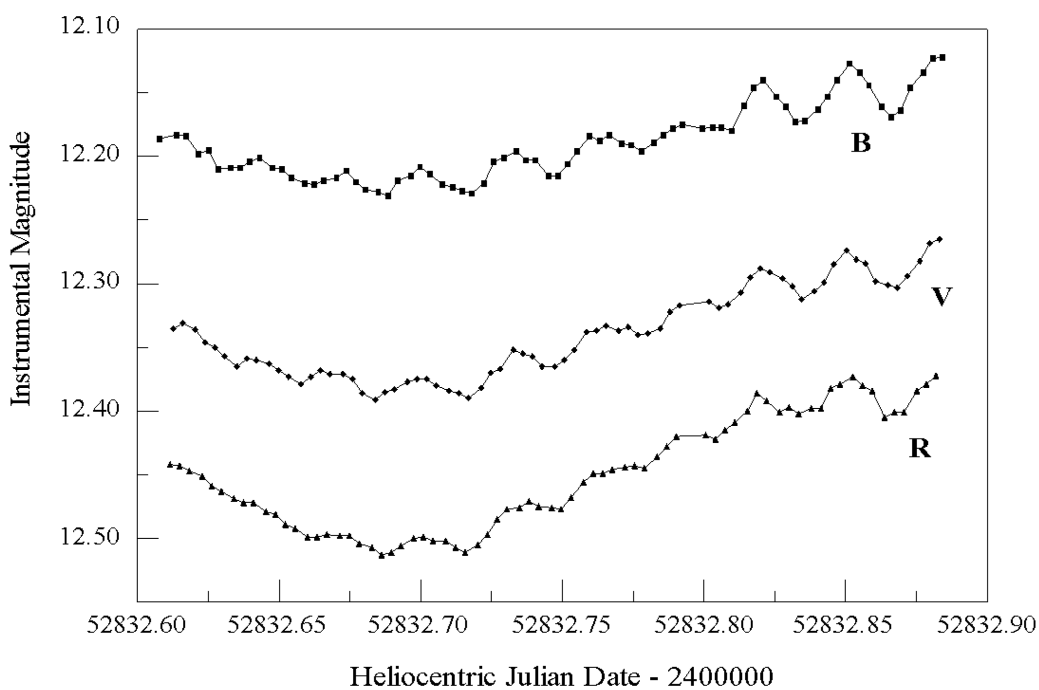

Figure 2. Primary eclipse of V469 Cyg on the night of UT 24 August 2003

Table 1. Times of minimum light.

Time of minimum (HJD-2400000)	Error	Filter	Type	O – C (GCVS)
50751.71107	0.00045	V	I	−0.07735
52832.68745	0.00059	B	II	
52832.68925	0.00058	V	II	
52832.69380	0.00057	R	II	
52876.66165	0.00079	B	I	−0.09018
52876.65885	0.00161	V	I	−0.09298
52876.66115	0.00077	R	I	−0.09068
52978.63930	0.00054	B	II	
52878.63995	0.00056	V	II	
52878.63880	0.00056	R	II	
52893.72150	0.00058	V	I	−0.09304

lost than in the B and R. The (O – C) values in Table I are computed with ephemerides from the General Catalog of Variable Stars (Kholopov et al., 1985).

A linear regression analysis of our times and those of Hoffmeister et al. (1954) and Whitney results in a new ephemeris for primary eclipse given by $HJD_{\rm min} = 2428814.3986 + 1.3125109E$.

The entry for V469 Cyg in Hegedüs's table of systems with eccentric orbits or displaced secondaries gives the secondary at phase 0.57. However, using our results we obtain a current phase of 0.508.

We are grateful for references provided by Greg Shelton and Brenda Corbin at the U.S. Naval Observatory Library. Other references were obtained at the NASA Astrophysics Data System. This work also made use of the SIMBAD data base and the Space Telescope Science Institute's Digitized Sky Survey. Support was also received from the National Science Foundation.

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ERRATUM FOR IBVS 5531

Figure captions in this issue are swapped, Fig. 1. shows the primary eclipse, while Fig. 2. is the secondary eclipse.

The Editors

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NEW ELEMENTS FOR 80 ECLIPSING BINARIES III.

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The publicly available ASAS-3 (Pojmanski, 2002) and Hipparcos (Perryman et al., 1997) databases have been used to prepare this third list presenting new elements for eclipsing binaries. Three catalogues have been used to detect the candidates for this study: the Hipparcos Catalogue, the New Catalogue of Suspected Variable Stars (NSV) (Kukarkin and Kholopov, 1982) and its supplement (NSVS) (Kazarovets et al., 1998). For more details on the selection of the candidate eclipsing binaries and data analysis, see Otero (2003). Elements were found with AVE (Barberá, 1999) and a Microsoft Excel period search utility kindly provided by Patrick Wils (Wils, 2003). Hipparcos observations have been transformed to V using a table by the author published electronically in IBVS No. 5482 (Otero, 2003b). Table 1 shows the list of variables. The first column gives the variable star designation according to the GCVS. The following columns give another identifier; the brightness range of the variable, with the magnitude of secondary eclipse between brackets; the epoch of minimum light derived from the complete dataset; the period; the variability class and the spectral type with a note to the spectral type source.

Table 1. New elements for 80 eclipsing binary stars.

Star Name		Magnitude range	Epoch	Period	Type	Spectral type
Variable	Other ID	(V)	(HJD2440000+)	(days)		
CE Cir	HIP 068750	7.93 – 8.11 (8.08)	8219.079	13.9324	EA	B9IV/V (1)
NSV 00763	GSC 7009 0216	10.58−11.17(10.82)	12129.860	6.11384	EA	
NSV 01175	GSC 8873 0040	10.83− 11.2 (11.2:)	12134.878	4.63963	EA	G5V(e?)(31)
NSV 01708	GSC 7592 0778	12.27−13.1 (12.95)	12215.706	3.6521	EA	
NSV 03489	GSC 5965 2026	11.13−11.60(11.53)	12215.795	2.53153	EA	
NSV 03725*	HIP 037763	8.31 – 8.68 (8.60:)	13042.680	12.3192	EA	B8/B9III (1)
NSV 03870	HD 066436	9.43 −10.07(10.02)	12723.645	0.446394	EW	F3V (2)
NSV 04226	GSC 6024 2103	12.28−14.7 (12.36)	12645.761	3.4331	EA	
NSV 04426	GSC 5470 0214	12.7 −14.1:(12.85:)	12031.470	1.89439	EA	
NSV 04677	GSC 6053 1042	10.04−10.76(10.10)	11932.715	2.2110	EA	
NSV 04686	GSC 8610 2627	12.16−12.66(12.54)	13018.820	7.1362	EA	
NSV 04711	GSC 9214 0576	12.6 − 13.3:(12.8:)	13018.786	0.79995	EA	
NSV 04941	GSC 8210 2662	12.72−¡14.5(12.85:)	12810.482	3.76173	EA	
NSV 05156	GSC 7734 0221	11.96−12.66(12.11)	12736.612	1.81033	EA	
NSV 05177	GSC 8217 0730	12.32−¡13.6(12.45:)	12934.800	2.63205	EA	
NSV 05487	GSC 8241 1098	11.72−¡13.7(11.85)	12759.622	1.95074	EA	
NSV 06061	GSC 8258 0787	11.24−13.05(11.43)	12738.740	3.5116	EA	

Table 1. New elements for 80 eclipsing binary stars.

Star Name		Magnitude range	Epoch	Period	Type	Spectral type
Variable	Other ID	(V)	(HJD2440000+)	(days)		
NSV 06091	HD 113764	10.30– 11.02(10.99)	12116.460	1.04222	EA/KE	A1/A2V (3)
NSV 06144	GSC 5543 1285	11.53– 12.22(11.85)	12879.487	0.454857	EW/KW	
NSV 06150	GSC 9521 0323	11.88– 12.6 (12.5)	12404.915	0.288906	EW/KW	
NSV 06208	GSC 8248 1062	11.81– 12.61(12.03)	12793.568	0.740645	EA	
NSV 06218*	HIP 065403	9.08 – 9.44:(9.42:)	12014.643	5.7945	EA	G5V (3)
NSV 06354	HD 118532	9.71 – 9.93 (9.87)	11984.818	0.793856	EB/KE	A6IV (2)
NSV 06488	GSC 6148 0142	11.75– 12.43(11.85)	13090.714	0.81672	EA	
NSV 06592	GSC 9252 1620	12.19– 13.3:(12.33)	11903.842	2.74188	EA	
NSV 06714*	GSC 8691 2843	11.49– 11.9:(11.9:)	11954.777	2.09093	EA	
NSV 06746*	GSC 7814 1992	11.26– 11.87(11.77)	12452.523	1.14153	EW/KE:	
NSV 06800	GSC 9007 4133	12.30– 13.85(12.45)	12643.849	2.43419	EA	
NSV 06921*	HD 133473	9.82 – 10.4:(10.4:)	11930.798	6.20673	EA	F5/F6V (2)
NSV 06933*	HD 133674	9.92 – 10.55(10.40)	12414.589	4.61052	EA	B9IV (3)
NSV 07038	GSC 9513 2469	12.37– 13.17(13.10)	12809.693	0.448784	EW	
NSV 07044	HD 136591	9.99 – 10.51(10.43)	13011.851	0.386773	EW	F8 (1)
NSV 07763*	HD 328368	9.99 – 10.45(10.10)	12452.575	1.78686	EA:	B5 (9)
NSV 07847*	HD 149450	8.17 – 8.51 (8.26)	12040.789	1.108897	EA	B3III (2)
NSV 07871*	HD 149647	9.17 – 9.6: (9.5:)	12860.710	7.9935	EA	A2mA3-A7 (1)
NSV 08564	GSC 9276 2787	11.50– 12.39(11.68)	11950.843	5.3275	EA	
NSV 09348	GSC 8729 0831	11.27– 12.07(12.06)	12563.539	1.05333	EA	
NSV 09482	GSC 8355 2072	12.4 – 13.4 (12.7)	11994.792	0.524694	EB/KW	
NSV 09948	GSC 9067 0173	11.32– 11.90(11.89)	12467.440	0.327111	EW	
NSV 10425	GSC 9290 1725	12.37– 13.9: (12.6)	12055.753	5.0543	EA	
NSV 10789*	GSC 8363 3070	11.60– 12.92(11.90)	11981.962	6.23975	EA	
NSV 11114	GSC 8368 0719	12.38– 14.6 (12.5)	12811.846	2.76857	EA	
NSV 11217	GSC 7927 0894	10.68– 11.51(10.80)	12712.879	1.00545	EA	
NSV 11381*	HD 174245	9.78 –10.81(10.20:)	12922.518	2.63743	EA:	B8 (24)
NSV 11425	GSC 8385 0036	12.7 – 14.5:(13.2:)	12831.888	0.88483	EA	
NSV 11764	GSC 8379 1399	11.37– 12.13(11.44)	12875.681	2.67524	EA	
NSV 11807	GSC 7427 0358	11.76–12.30(12.23:)	12740.875	0.948834	EA	
NSV 12215	GSC 0479 0823	10.61– 11.15(11.07)	12481.639	0.531737	EW/KW	K2 (14)
NSV 12710	GSC 5746 0936	11.68– 12.3 (11.9:)	12213.521	1.14177	EA	
NSV 13404*	HD 199063	10.64– 11.25(10.93)	12175.543	0.597959	EB/KE	A2/A3V: (2)
NSV 13527	GSC 8793 0788	12.15– 14.12(12.35)	12930.544	2.85739	EA	
NSV 13605	HD 201964	8.38 – 8.84 (8.77:)	12104.716	2.69592	EA	A2mA7/8-A8/9 (2)
NSV 13608	GSC 9469 0599	12.66– 13.7 (13.0)	12085.710	0.510696	EB	
NSV 13711	GSC 7482 0186	11.31– 12.68(11.44)	12500.634	1.86244	EA	
NSV 13717	GSC 7991 0677	10.91– 11.34(11.00)	12831.720	0.801683	EA	
NSV 13766	GSC 9322 0006	12.05– 12.7 (12.7)	12900.626	0.390816	EW	
NSV 13890*	HD 207570	9.28 – 9.56(9.54:)	12844.790	0.373882	EW	F6V(+A/F) (3)
NSV 14003	GSC 7995 0354	11.79– 12.42(12.24)	12996.535	0.601954	EB/KE	
NSV 14163	GSC 9340 0292	12.6 – 13.4 (12.93)	12563.625	0.832102	EA	
NSV 14164	HD 212936	9.53 – 9.97 (9.87)	12770.852	3.64523	EA	F0IV/V (1)
NSV 14384*	GSC 9338 1173	11.5 – 11.95(11.85)	11869.540	121.21	EB/GS	
NSV 14532	HD 214505	9.37 – 10.04(10.02)	12992.612	0.336029	EW/KW	K1V (29)
NSV 17233	HIP 033274	7.88 – 7.98 (7.98)	8323.304	3.01351	EA	B8III (4)
NSV 17258*	HIP 033538	8.71 – 8.86 (8.77)	8701.550	50.363	EA	Fm del Del (5)
NSV 17336*	HIP 034262	8.25 – 8.43 (8.34)	13067.651	2.98260	EA	B3V (4)
NSV 18132*	HIP 044550	8.89 – 9.06 (9.05)	8311.779	10.31168	EA/DM	G3V (2)
NSV 18183*	HIP 045945	8.45 – 8.55 (8.55)	12764.617	6.64046	EA	A0V (3)
NSV 18424	GSC 8956 1910	12.5 – 13.3:(13.1:)	11919.730	2.87362	EA	B8V (14)
NSV 19453*	HD 110116	10.06– 10.5:(10.32)	12135.445	15.493	EA	B9IV (1)
NSV 19983	GSC 1473 1049	10.25– 10.59(10.57)	12751.746	0.53152	EW	F0 (28)
NSV 20009*	HIP 068339	8.42 – 8.62(8.62:)	7917.350	15.5543	EA/DM	B9V (1)
NSV 20245	GSC 6769 0476	11.07– 11.70(11.33)	11996.772	0.782983	EA:	
NSV 20721*	HIP 081604	7.61 – 7.80 (7.77:)	8180.587	20.9659	EA	A2IV (1)

Table 1. New elements for 80 eclipsing binary stars.

Star Name		Magnitude range	Epoch	Period	Type	Spectral type
Variable	Other ID	(V)	(HJD2440000+)	(days)		
NSV 24926	GSC 6903 0105	10.76−11.08(10.95)	12529.568	0.80681	EB	
NSV 25992*	HIP 113654	8.13 – 8.19 (8.19)	8560.500	1.424797	EA:/KE:	A8V (27)
V0362 Pup*	HIP 034659	7.49 – 7.66 (7.66:)	8258.268	9.26581	EA	A2Vs (2)
V0920 Her	HIP 082390	7.87 – 7.98 (7.97)	7954.497	6.92644	EA	A0 (28)
V1000 Cen*	HIP 069980	8.40 – 8.67 (8.63:)	12102.514	16.6336	EA	B8IV (1)
V1375 Ori	HIP 025902	6.66 – 6.85 (6.72)	7915.300	146.33	EA/GS	K0/1III (5)
V1384 Ori	HIP 028142	7.21 – 7.45 (7.29)	8702.336	3.28023	EA	B2V (30)

Sources of spectral type: (1) Houk and Cowley, 1975. (2) Houk, 1978. (3) Houk, 1982. (4) Houk and Smith-Moore, 1988. (5) Houk and Swift, 1999. (9) Nesterov et al., 1995. (14) Kholopov et al., 2003. (24) Ochsenbein, 1980. (27) Grenier et al., 1999. (28) Kharchenko, 2001. (29) Metanomski et al., 1998. (30) Guetter, 1968. (31) Torres et al., 2000.

Notes on individual stars:

NSV 03725 = Eccentric system.
NSV 06218 = One HIP eclipse recorded but not classified as variable in the HIP catalogue. Period might be half the value given.
NSV 06714 = Primary eclipse might be the secondary.
NSV 06746 = Might be EB-type.
NSV 06921 = Period might be half the value given.
NSV 06933 = Very eccentric system.
NSV 07763 = EB-like.
NSV 07847 = Bright peak in the middle of Min II. Strong reflection effect.
NSV 07871 = Uncertain eclipse depths.
NSV 10789 = O'Connell effect. Max. II $V = 11\overset{\mathrm{m}}{.}63$.
NSV 11381 = EB-like.
NSV 13404 = Strong O'Connell effect. Max II $V = 10\overset{\mathrm{m}}{.}70$.
NSV 13890 = Classified as DSCT:/EW: by Piquard (2001) with a period of 0.373868 d.
NSV 14384 = Tycho-2 $B - V = 1\overset{\mathrm{m}}{.}57$.
NSV 17233 = Period might be half the value given. Min I might be min II. Visual binary. $A = 8\overset{\mathrm{m}}{.}1; B = 9\overset{\mathrm{m}}{.}7$ Hp. Sep. $0\overset{''}{.}29$ (Perryman et al., 1997)
NSV 17258 = Slightly eccentric system.
NSV 17336 = Eccentric binary. Visual binary (sep. $2\overset{''}{.}66$) made Hipparcos data completely useless.
NSV 18132 = Period might be half the value given. Visual binary $9\overset{''}{.}4$ (Dommanget & Nys, 2002)
NSV 18183 = Period might be half the value given.
NSV 19453 = Eccentric system.
NSV 20009 = Period might be half the value given. Visual triple. $A = 8\overset{\mathrm{m}}{.}5; B = 11\overset{\mathrm{m}}{.}4$ Hp. Sep. $7\overset{''}{.}32$ (Perryman et al., 1997). $C = 12\overset{\mathrm{m}}{.}8$ B (Egret et al., 1992). The AC sep. is $44''$ (Worley and Douglass, 1997).
NSV 20721 = Period might be half the value given.
NSV 25992 = Min I might be Min II. Visual binary. $A = 8\overset{\mathrm{m}}{.}5; B = 9\overset{\mathrm{m}}{.}9$ Hp. Sep. $3\overset{''}{.}96$ (Perryman et al., 1997). Koen and Eyer (2002) give per= 0.7124 d.
V0362 Pup = Visual binary. $A = 7\overset{\mathrm{m}}{.}8; B = 9\overset{\mathrm{m}}{.}4$ Hp. Sep. $0\overset{''}{.}69$ (Perryman et al., 1997).
V1000 Cen = Eccentric system. Primary eclipse might be the secondary.

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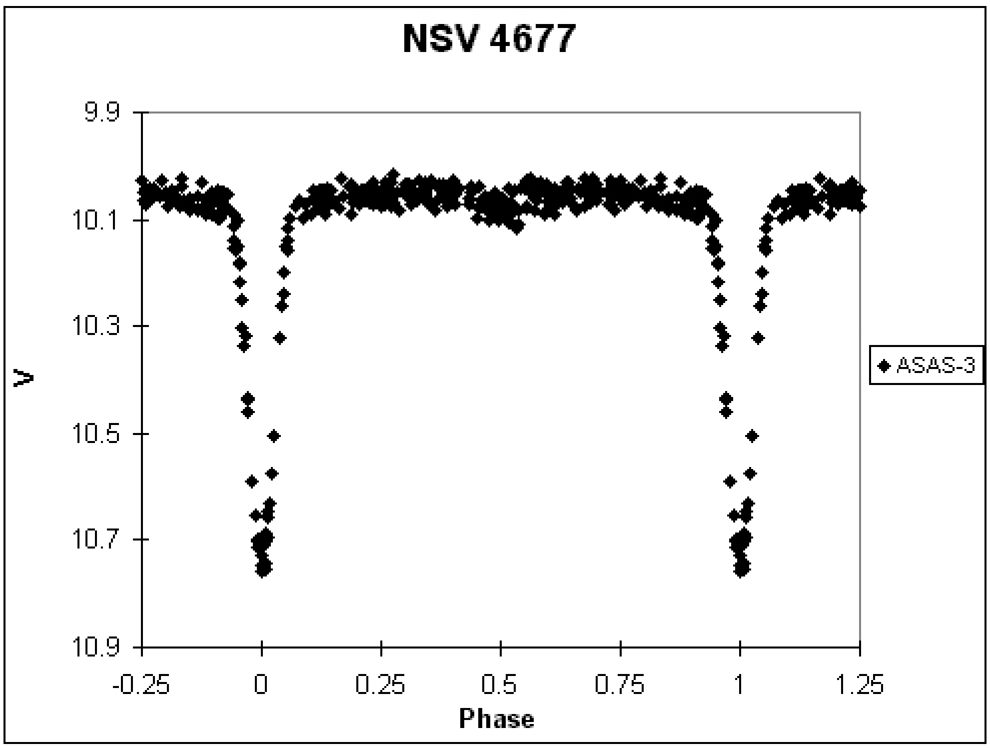

Figure 1. Lightcurve of NSV 04677 showing ASAS-3 data.

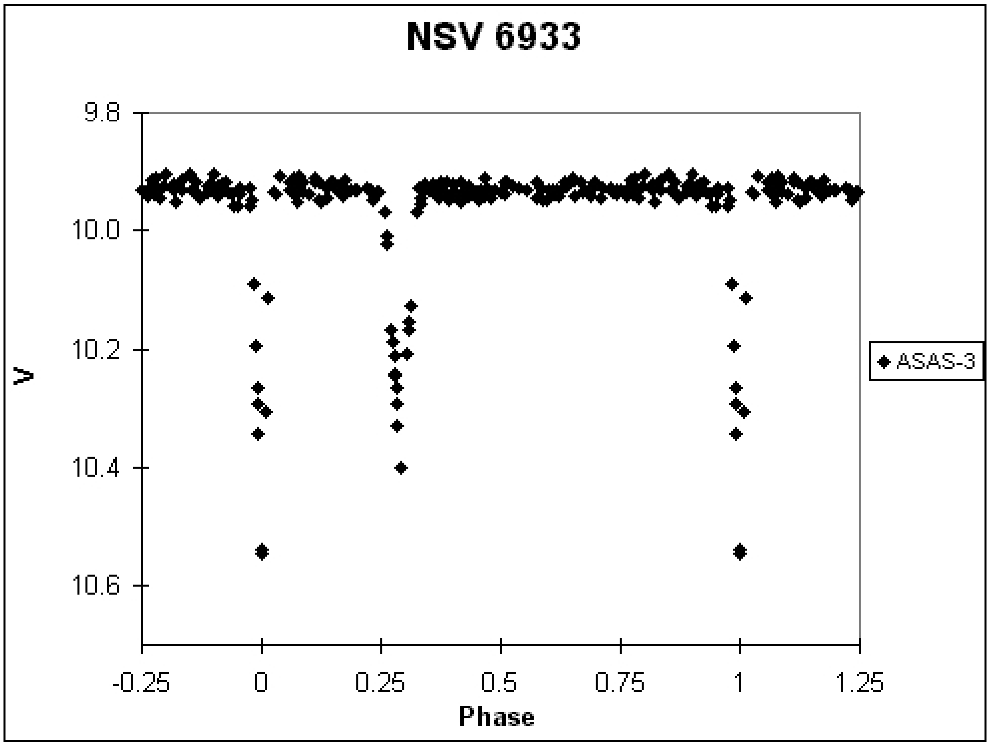

Figure 2. Lightcurve of NSV 06933 showing ASAS-3 data.

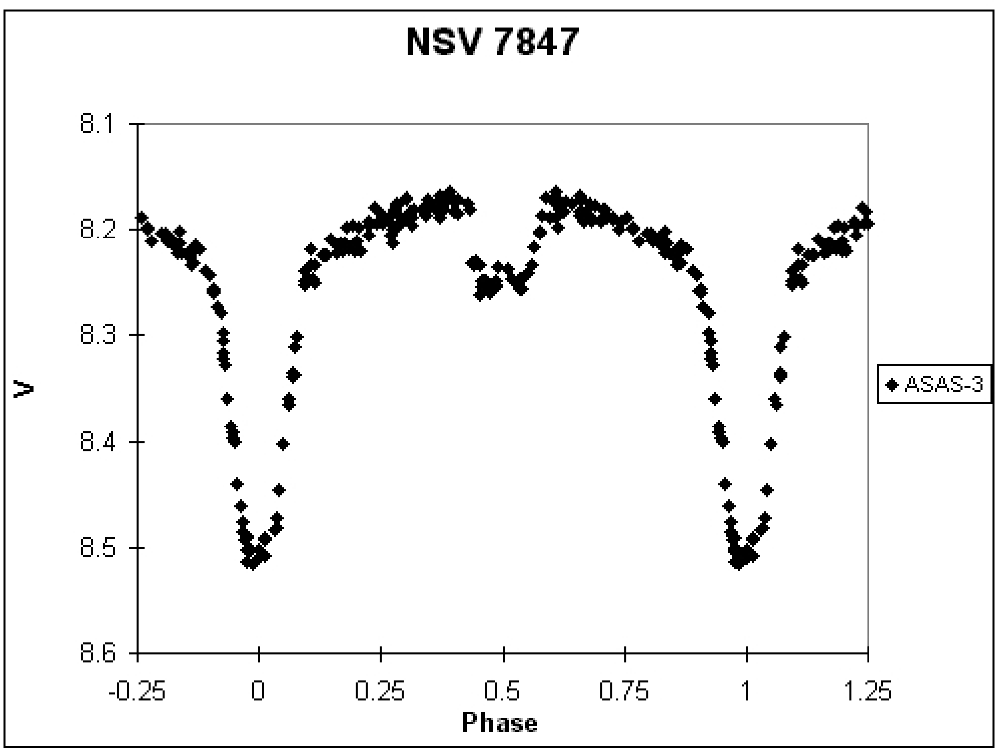

Figure 3. Lightcurve of NSV 07847 showing ASAS-3 data.

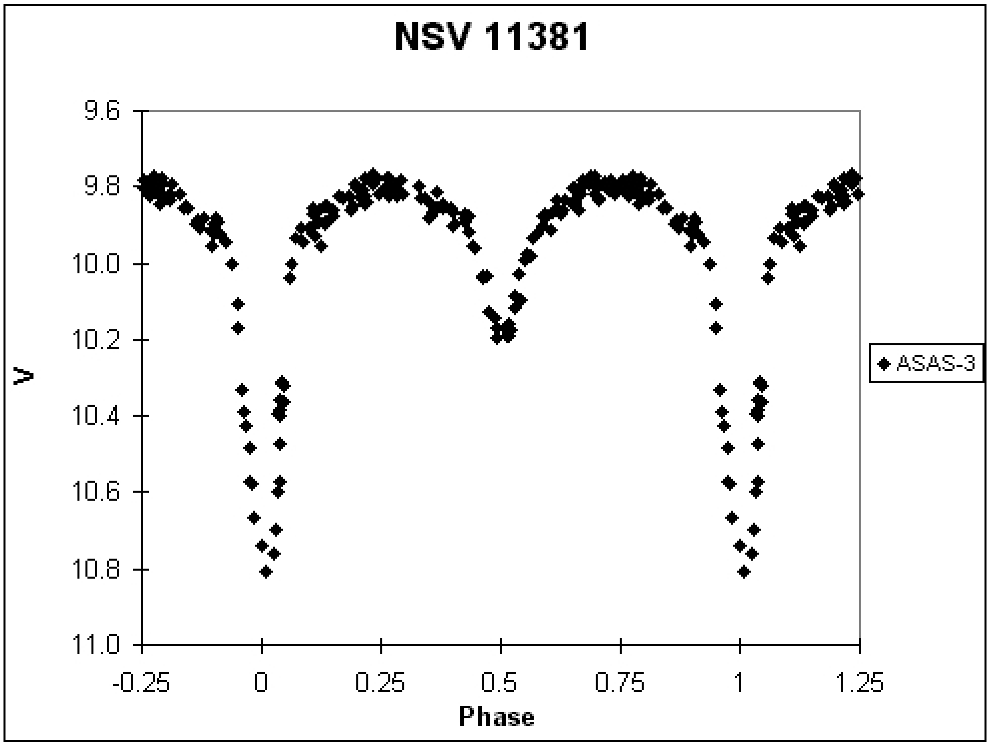

Figure 4. Lightcurve of NSV 11381 showing ASAS-3 data.

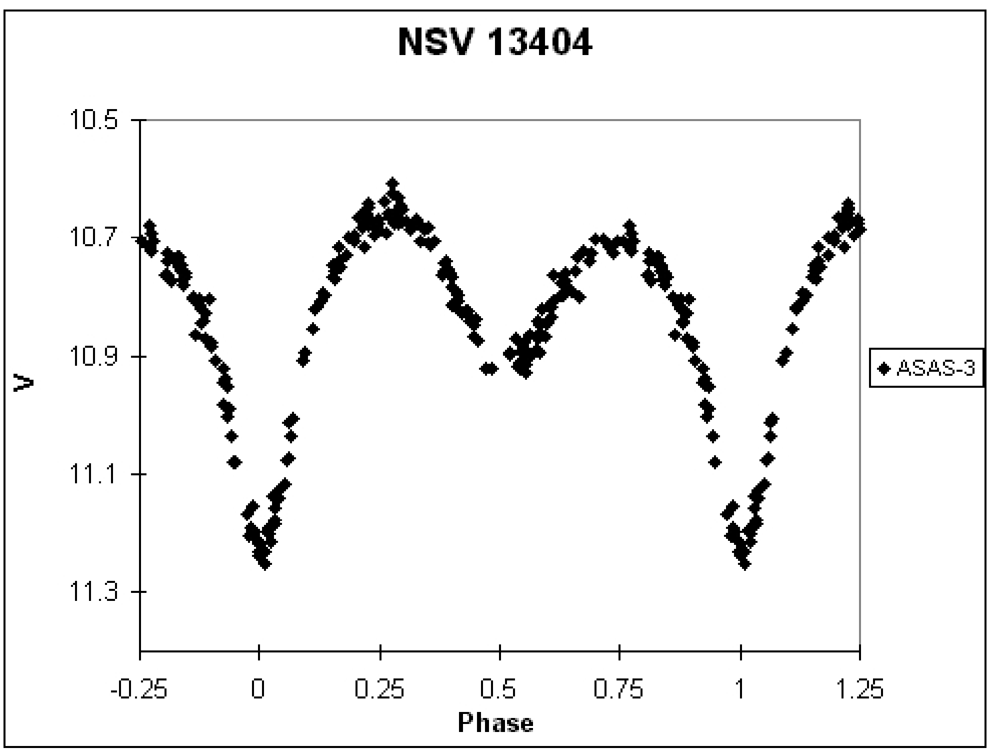

Figure 5. Lightcurve of NSV 13404 showing ASAS-3 data.

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ERRATUM FOR IBVS 5532

Geert Hoogeveen reported the following error:

IBVS No.	item	printed	correct
5532	identifier (NSV 14532)	HD 214505	HD 220345

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NEWLY DISCOVERED VARIABLE STARS IN THE GLOBULAR CLUSTER NGC 1851

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The Galactic globular cluster NGC 1851, which has recently been associated, along with NGC 2808, with a previously unknown dwarf galaxy in Canis Major (Martin et al. 2004), belongs (again like NGC 2808) to a relatively rare group of clusters that display bimodal horizontal-branch (HB) morphology (Catelan et al. 1998 and references therein). We have recently discovered a sizeable RR Lyrae population in NGC 2808 (Corwin et al. 2004). Here we report on the discovery of 19 previously unknown variables in NGC 1851.

Prior to our study, thirty-three variables were known in NGC 1851, 29 of which of the RR Lyrae type. The RR Lyrae variables in NGC 1851 have most recently been studied by Walker (1998). The CCD images used in the present study were obtained with the Danish 1.54-m telescope located at the European Southern Observatory at La Silla, Chile. The instrument used was the DFOSC with a field of view of $13'.7 \times 13'.7$. The data reported here are from four nights, 2002 December 11/12 and 12/13 amd 2003 February 18/19 and 19/20. The seeing was around 1.0 arcsec or better. Image-subtraction (Alard & Lupton 1998; Alard 2000) analysis results are reported here for 65 B (December) and 83 B (February) images.

The location and tentative period of the variables are given in Table 1.The x and y coordinates are given in arcseconds and with respect to the cluster center, given in the Clement et al. (2001) catalog as R.A. $05^{\rm h}12^{\rm m}.4$ and Dec $-40°05'.0$ (1950). Because the data are relatively limited, the periods are not definite. Light curves based on the periods given in Table 1 are shown in Figure 1. Because two different reference frames were used to determine the differential flux for December and for February, the light curve data for December were adjusted to match as closely as possible the light curve data for February. Thus the exact relationship between these data sets might not be as shown in Figure 1. When the new variable was found in both the December and the February data, the different symbols represent data from each of the two runs. NV6, NV7, NV9, NV18, and NV19 were found only in the February data and in those cases the different symbols represent data from the two consecutive nights.

As for the previously known variables, it should be noted that the period 0.426653 d given in Walker (1998) for V31 does not phase our December/February data properly. Our data suggest that the period may be either approximately 0.0016 d shorter or 0.0011 d longer than Walker's period.

As can be seen from Table 1 and Figure 1, we have likely detected about 15 previously unknown RR Lyrae variables in NGC 1851. Together with the 29 variables of this type previously known, this raises the specific frequency of RR Lyrae variables in the cluster from $S_{\rm RR} = 13.5$ (Harris 1996) to $S_{\rm RR} \simeq 20.5$.

Table 1. Locations and tentative periods for new variables.

Variable	$x('')$	$y('')$	Period (d)	Type
NV1 (V34)	38.77	−10.87	0.515	RRab
NV2 (V35)	22.18	4.31	0.321	RRc
NV3 (V36)	14.07	12.49	0.318	RRc
NV4 (V37)	12.26	−13.97	0.350	RRc
NV5 (V38)	3.52	−13.30	0.75?	RRab?
NV6 (V39)	3.27	−1.46	0.573	RRab
NV7 (V40)	0.59	12.32	0.503	RRab?
NV8 (V41)	−1.26	5.89	0.400	RRab?
NV9 (V42)	−1.46	−3.10	0.341	RRc
NV10 (V43)	−2.14	10.31	0.283	RRc
NV11 (V44)	−2.73	0.83	0.253	RRc?
NV12 (V45)	−4.68	17.77	0.389	RRab
NV13 (V46)	−7.06	−0.80	0.297	RRc
NV14 (V47)	−14.92	14.48	0.283	RRc
NV15 (V48)	−21.22	−6.12	0.520	RRab
NV16 (V49)	−23.30	−1.80	0.267	RRc
NV17 (V50)	−38.58	−28.44	0.327	RRc
NV18 (V51)	−41.86	31.50	0.507	RRab
NV19 (V52)	−44.82	21.60	0.401	?

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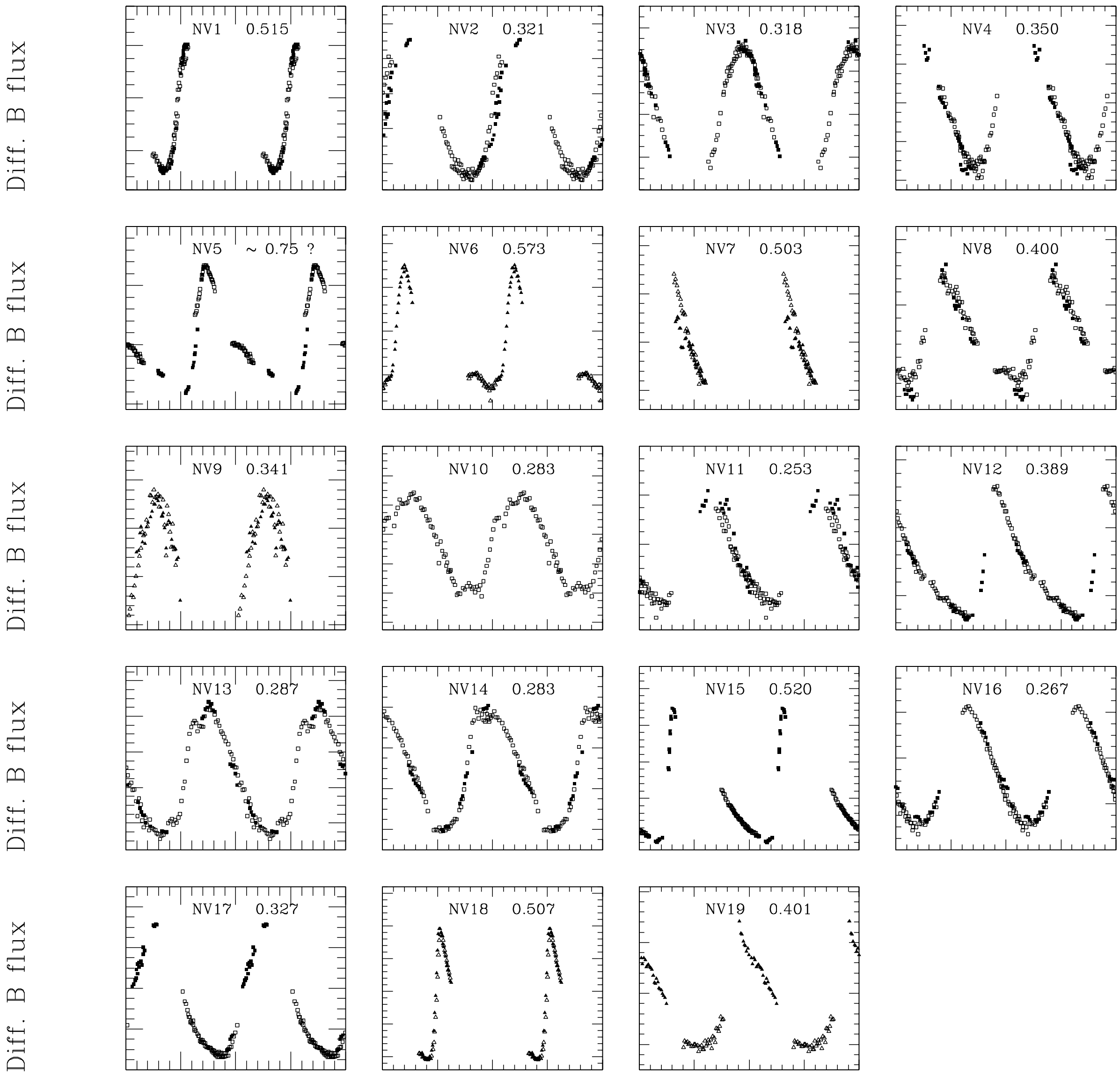

Figure 1. *B*-band light curves for newly detected variable stars in NGC 1851. ISIS relative fluxes are shown in all cases. The candidate period used to phase the light curves is given in each plot. Note that such periods are quite uncertain in some cases.

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THE SPOTTED STAR BD+52°1602

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By studying stars with active regions we hope to further our understanding of the solar dynamo. These stars are generally X-ray sources with periodic sinusoidal photometric variations. The ROSAT satellite has scanned the sky and an entry in the catalog (Voges et al., 1999) of the X-ray sources: 1RXSJ120027.6+515722 is the star BD+52°1602 = GSC 3457-1012. The Hipparcos Input Catalogue (ESA 1997) denotes it as HIP 58557 and has its parallax listed as 14.58 ± 2.71 mas giving a nominal distance of about 58 to 84 parsecs. Its (B-V) is listed as 1.22 and $(V-I)_C = 1.38$, which indicate a spectral class of K6V±1; and 2MASS measurements of BD+52°1602 reveal that J=9.24, H=8.63 and K=8.46 all with an uncertainty of about ±0.02. All these colour measurements are consistent with a spectral class of K7V±1. Assuming a main sequence K star implies an absolute magnitude of about $M_V = 7.9 \pm 0.3$ so with an apparent magnitude of $V_T = 11.7 \pm 0.1$ a second estimate of the distance would be about 56 ± 8 parsecs, in agreement with the Hipparcos parallax.

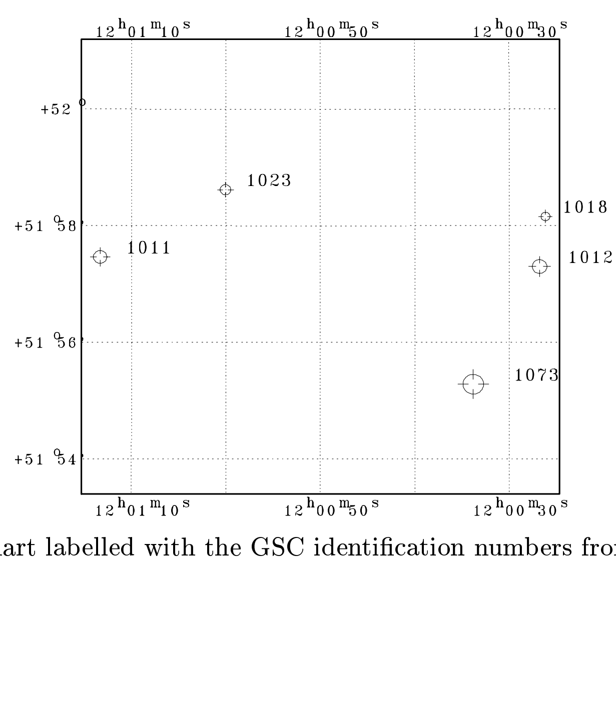

Figure 1. Finder chart labelled with the GSC identification numbers from region 3457.

Table 1: Stars observed in the field of GSC 3457-1012

Star GSC Id	R.A. J2000	Dec. J2000	GSC Mag.	ΔR Mag.	Std Dev Between	Std Dev Within
1012	$12^h00^m27^s$	$51°57'18''$	11.4	1.540	0.015	0.006
1073	$12^h00^m34^s$	$51°55'17''$	9.9	-	-	-
1018	$12^h00^m26^s$	$51°58'09''$	12.8	3.052	0.005	0.012
1023	$12^h01^m00^s$	$51°58'37''$	12.4	2.591	0.004	0.007
1011	$12^h01^m13^s$	$51°57'28''$	11.6	2.015	0.004	0.006

The University of Victoria (UVic) observations were made with our automated 0.5m telescope, Star I CCD and reduced in a fashion similar to that described in Robb and Greimel (1999). The field of stars observed is shown in Figure 1. The Julian Dates of observation (-2450000) are 3104-6, 3111-12, and 3117-26. Table 1 lists the stars' identification numbers and magnitudes from the Hubble Space Telescope Guide Star Catalogue (GSC) (Jenkner et al., 1990). All UVic observations were made using a filter identical to the Cousins R.

The period of variations was indeterminate from our observations so TJK began observations from Tashkent. He used a Celestron C-11 telescope with a SBIG ST-7 CCD binned 2×2. His exposure times were 30 seconds with no filter. He used the same comparison star and we found that his observations could be combined with our Cousins R observations with zero offset and no scale change. His observations were made on Julian Dates (-2450000) 3126, 3128 and 3129.

Our differential ΔR magnitudes are calculated in the sense of the star minus GSC 3457-1073 . Brightness variations during a night were measured by the standard deviation of the differential magnitudes and are listed for the most photometric night in the last column as "Std Dev Within". A "Std Dev Within" one night of 0.006 sets an upper limit on variations of an hourly timescale. For each star the mean of the nightly means is shown as ΔR in Table 1. The standard deviation of the nightly means is a measure of the night to night variations and is called "Std Dev Between" in Table 1. The smallest "Std Dev Between" is 0.004 magnitudes. This excellent photometry shows that night to night variations in GSC 3457-1073 must be less than a few millimagnitudes.

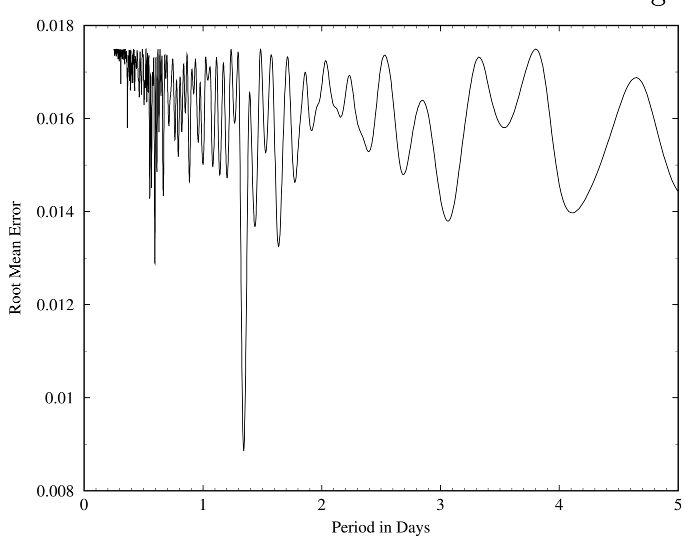

Figure 2. Periodogram for sine curve fit to all photometric data

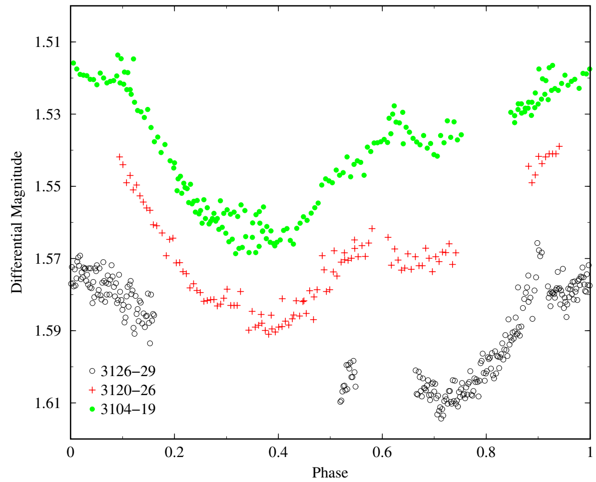

Figure 3. R filtered light curve of BD+52 1602 with different runs offset by +0.02 magnitudes and marked with different symbols.

The star BD+52°1602 varied in brightness during some nights and had variations from night to night. Sine curves of various periods were fitted to the data and the Root Mean Square Error is plotted as a function of period in Figure 2. Plots of the light curve at the period corresponding to each of the minima of chi squared showed that the only reasonable period was approximately $1.336 \pm .006$ days. A plot at twice this period did not show any improvement in the scatter. Our best estimate of the present ephemeris is:

$$\text{HJD of Maximum Brightness} = 2453104\overset{\mathrm{d}}{.}2(1) + 1\overset{\mathrm{d}}{.}336(6) \times \mathrm{E}.$$

where the uncertainty in each final digit is given in brackets. Six of the individual ΔR_C magnitudes were averaged and in Figure 3 these normal points phased at this period are plotted. The data are divided into three parts to show that there have been changes in the shape of the light curve even over the month of observations. These changes are typical of spotted stars such as BY Draconis and are probably due to spot area and/or position changes.

There exist Hipparcos/Tycho (ESA 1997) photometric data of this star and the data from Julian Date 2448136-8142 clearly show a photometric variation with a period of $1.36 \pm .16$ days. The data from Julian Date 2448100-8500 show the variation less clearly but refine the period to $1.339 \pm .003$ and indicate that the variation can stay in phase for about a year. This period agrees with the period found from our data, but the error is too large to determine if the variation is in phase. The rest of the Hipparcos data and the ROTSE (Wozniak et al., 2004) data do not show a clear variation. It is likely that the amplitude of the variation changes with time and this hinders our determination of a precise period. The period may not even be constant over long time spans since the star may experience differential rotation.

A spectrum of BD+52°1602 observed with the Dominion Astrophysical Observatory's 1.8m telescope is shown in Figure 4. The time of observation was 06:00 UT 6 May 2004, which corresponds to a phase of approximately 0.62. The Calcium II emission lines are a characteristic of stars with active regions. The strength of the Calcium I 4227Å line is typical of a mid-K spectrum and the Cr I 4290Å and Fe I 4326Å lines indicate a K6V±1 spectral classification consistent with the color measurements.

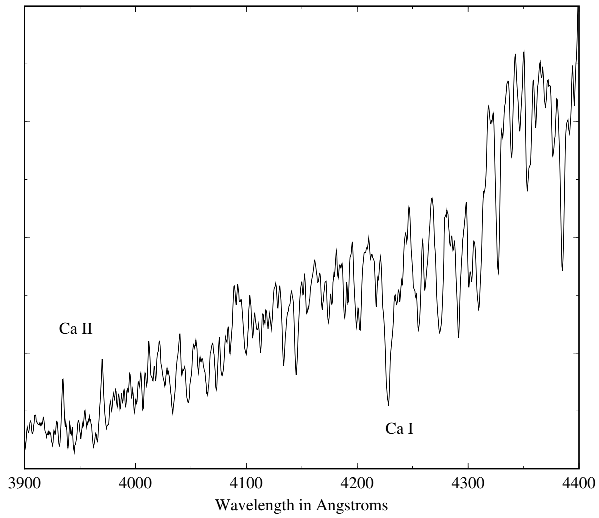

Figure 4. Spectrum of BD+52°1602 showing the Calcium I absorption line and the Calcium II emission lines

BD+52°1602 seems to be a rapidly rotating late type dwarf star with active regions covering a significant part of its surface and energizing a hot corona producing X-rays. Further spectral observations will be of interest to see if the Ca II emission will vary in intensity with phase. Further photometric observations will be important to tell if differential rotation will modify the period and/or shape of the light curve and to determine the period of the spot cycle (Oláh et al. 2000)

Acknowledgements

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THE DETACHED SOLAR-TYPE BINARY CV Boo

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Guest User, Canadian Astronomy Data Centre, which is operated by the Dominion Astrophysical Observatory for the National Research Council of Canada's Herzberg Institute of Astrophysics.

CV Boo (= BD +37°2641 = GSC 2570-0843) was discovered to be a possible eclipsing binary by Peniche et al. (1985) during a study of the Delta Scuti star YZ Boo. Busch (1985) made a study of 515 Sonneberg Sky Patrol Plates, determined 27 times of minima, and derived a period of 0.8469935 days. He also confirmed it as an eclipsing type and classified it as EA. Since then, numerous other workers have derived accurate times of minima, refining the period (see Nelson, 2004). The following elements were used for phasing:

$$\text{JD Hel Min I} = 52723.3207 + 0.8469938\ \text{E}$$

Popper (2000) did a spectroscopic study of four late F – K main sequence eclipsing binaries, deriving a radial velocity (RV) solution for CV Boo.

In the present study, photometric observations were carried out in 2003 March – June at the Sylvester Robotic Observatory in the V and I_c bands; 229 and 246 values in V and I_c were obtained, respectively. Images were reduced in the usual way with MIRA, by Axiom Research (for Windows; this platform was used throughout the study). (See Nelson 2002a for more details.) Comparison stars are listed in Table 1; the magnitudes are from the Tycho catalogue (ESA 1997).

Table 1. Positions and magnitudes

Star	GSC 2570-	RA (hh.mmss)	Dec (dd.mmss)	V	$B-V$
CV Boo	0843	15.2619	36.5853	10.75	0.73
Comp	0869	15.2707	36.5927	10.55	0.74
Check	0511	15.2652	36.5632	10.26	1.41

Twelve high-resolution (10 Å/mm) spectra were taken in 2003-2004 at the Dominion Astrophysical Observatory (DAO) in Victoria, British Columbia. (The spectral range was 4888-5150 Å). A log of observations and the derived heliocentric radial velocities (RVs) are presented in Table 2 and a list of IAU Standard Radial Velocity Stars (Roberts & Boksenberg, 1986) from which the CV Boo RVs were derived is given in Table 3.

Initial reductions of images (bias and cosmic ray removal) were preformed by MIRA. Intermediate reductions (overscan removal, setting apertures, fitting background, summation of counts, reduction to 1 dimension, calibration from Fe-Ar arc spectra, and finally dispersion correction) were performed by 'Ravere', software developed by the author. Final determination of radial velocities was performed by 'Broad', also software developed by the author that uses the Rucinski broadening functions (Rucinski, 2004). As expected, there was some scatter in the values for a given CV Boo spectrum from the various RV standard spectra. The mean and standard deviation were taken and those values lying outside twice the sample standard deviation were rejected. In this way, the standard deviations for each RV determination averaged 3.5 km/s; the rms deviation from the best-fit WD radial velocities was 14.3 km/s.

Table 2. Log of DAO observations and RV results

DAO Image #	Start time (HJD-240000)	Exposure (sec)	Phase at mid-exp	(km/s) V1	(km/s) V2
2487	52778.9382	3000	0.685	108.5	−133.2
4032	52807.7819	3600	0.743	136.6	−153.7
0773	53097.8980	3600	0.268	−138.9	118.2
0849	53098.7776	3600	0.306	−130.7	129.7
0879	53099.9480	3600	0.688	114.7	−143.2
0882	53099.9989	3600	0.748	137.3	−144.5
0918	53101.8284	3600	0.908	92.7	−75.1
0945	53103.7373	3600	0.162	−137.3	108.2
0983	53104.7261	3600	0.329	−117.8	120.7
0996	53104.9305	3600	0.571	65.34	−65.5
1044	53105.9844	3600	0.815	120.1	−134.3
1094	53107.9154	3600	0.095	−82.4	74.9

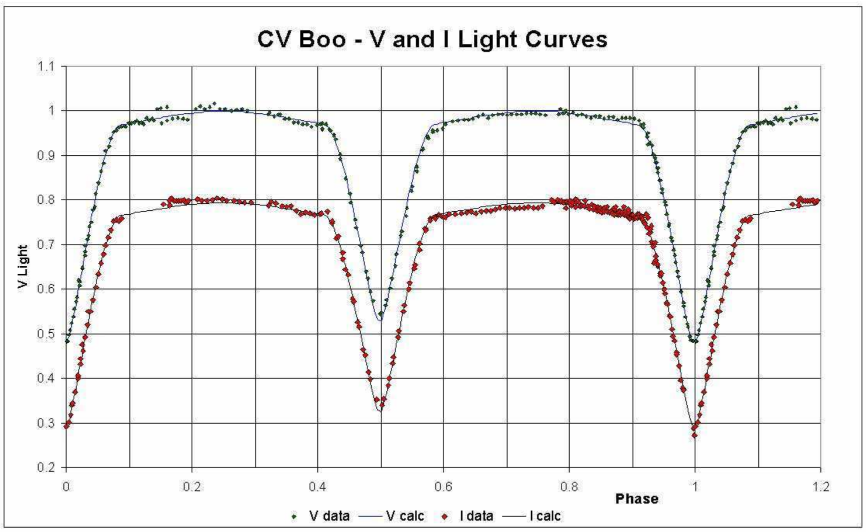

Figure 1.

In order to estimate the surface temperatures, T_1 and T_2, the following analysis is used: Simple double sine wave fitting of the radial velocity curves gives $K_1 \sim 138$ km/s and $K_2 \sim 140$ km/s, giving a spectroscopic mass ratio $q = M_2/M_1 = 0.986$. The speed in the relative orbit (assumed circular with inclination close to 90 degrees) is V = 278 km/s giving an orbital radius $R = VP/2\pi = 0.0215$ AU, where P = period = 0.847 days = 0.002164 years. Kepler's third law (as modified by Newton) gives the total mass $M_{tot} = R^3/P^2 = 1.885$ solar masses. Using the above value for the mass ratio gives $M_1 = 0.95$ and $M_2 = 0.94$ solar masses respectively. Allen (1973) then gives the spectral types as G3 and G4, leading to temperatures of 5784 and 5696 K (Flower, 1996), and log g values of 4.444 and 4.450 (cgs) respectively. Limb darkening values were found from van Hamme's tables (van Hamme, 1993). These values were used throughout the subsequent modelling; they agreed with the values from the best-fit model.

The photometric and RV data were analyzed by the Wilson-Devinney (WD) light curve analysis program (Wilson and Devinney, 1971, Wilson, 1990), using an interface program written by the author (see Nelson, et al., 2002b). The general appearance of the curve suggested a detached binary; hence mode 2 was chosen. Convective envelopes (appropriate for solar-type stars) were supposed, giving albedos $A_1 = A_2 = 0.5$ and gravity exponents $g_1 = g_2 = 0.32$.

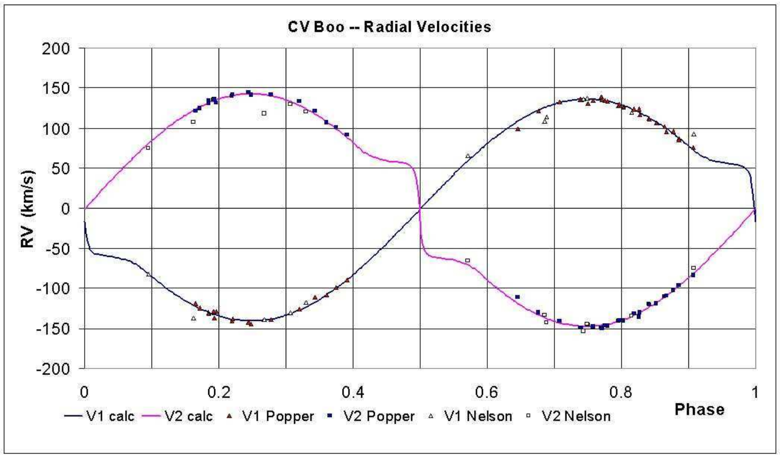

Figure 2.

Table 3. IAU standard RV stars used

Star HD -	RA (hh.mmss)	Dec (dd.mmss)	Sp. Type	V (mags)	RV (km/s)
76932	08.5844	−16.0759	F7-8 IV-V	5.80	119.2
89449	10.1946	+19.2806	F6 IV	4.78	6.3
102870	11.5041	+01.4555	F8 V	3.59	4.3
122693	14.0252	+24.3343	F8 V	8.11	−5.5
126053	14.2315	+01.1434	G1 V	6.25	−19.3
140913	15.4508	+28.2811	G0 V	8.06	−20
144579	16.0457	+39.0923	G8 V	6.66	−59.5
149803	16.3554	+29.4444	F7 V	8.58	−7.5
154417	17.0517	+00.4225	F9 V	6.00	−16.8
184467	19.3109	+58.3513	K1 V	6.60	11.2
184499	19.3327	+33.1205	G0 V	6.62	−166.1
187691	19.5102	+10.2458	F8 V	5.12	0

Table 4. Solution parameters

Quantity	Value		Error	Quantity	Value	Error
	Star 1	Star 2				
F	1.000	1.000	[fixed]	L1/(L1+L2) (V)	0.525	0.006
g	0.320	0.320	[fixed]	L1/(L1+L2) (I)	0.517	0.006
A	0.500	0.500	[fixed]	o	−0.0017	0.0001
x (bol)	0.186	0.207	[fixed]	e	0	0.0006
y (bol)	0.530	0.510	[fixed]	a (solar radii)	4.671	0.067
x (V)	0.246	0.283	[fixed]	V (km/s)	−0.033	0.016
y (V)	0.591	0.558	[fixed]	r1 (pole)	0.2562	0.0016
x (I)	0.055	0.086	[fixed]	r1 (point)	0.2699	0.0020
y (I)	0.632	0.606	[fixed]	r1 (side)	0.2606	0.0017
T1 (K)	5784	—	200	r1 (back)	0.2668	0.0019
T2 (K)	—	5639	6.9	r2 (pole)	0.2571	0.0021
	4.844	4.759	0.030	r2 (point)	0.2720	0.0027
f (fill factor)	−2.153	−1.992	0.050	r2 (side)	0.2617	0.0023
q = M2/M1	0.9708		0.0085	r2 (back)	0.2685	0.0025
i (deg)	87.89		0.13	res2	0.0139	0.00131

The square root (LD=3) limb darkening law was chosen, appropriate for infrared light curves (Bessell, 1979). Grid sizes were the same as in Nelson et al. (2002b). First black body radiation, later the atmosphere option of WD with Carbon and Gingerich atmospheres (Carbon & Gingerich, 1969) were used.

After a best-fit solution was found, third light was tested for and the predicted correction was less than the estimated error. Therefore third light may be ruled out. Similarly, quantities F_1 and F_2 (the ratios of axial to orbital rotation rates) were varied; however the corrections were again less than the errors, therefore values of unity (and hence synchronous rotation) may be assumed. A similar test was done against eccentricity $e = 0$ with the same null results. The final values are given in Table 4, the final light and radial velocity curves are plotted in Figures 1 and 2, and the derived fundamental values are summarized in Table 5 (where s.u. = "solar units").

It should be noted that the errors quoted in Tables 4 and 5 are formal (internal) errors provided by the WD program; actual errors may be several times those. With that caveat, the results are in essential agreement with Popper (2000). He has $q = M_2/M_1 = 0.9502(43)$ and, using the value of inclination obtained here, we get $M_1 = 1.056(6)$ and $M_2 = 1.003(7)$ where the figures in brackets are the errors in units of the last digit. His semi-major axis of the relative orbit is 4.7889(70) solar radii, also in essential agreement.

Table 5. Fundamental parameters

	Star 1	Star 2	Error
Spectral Type	G3	G4	—
Mass (s.u.)	0.97	0.94	0.03
Radius (s.u.)	1.22	1.23	0.01
Density (s.u.)	0.53	0.52	0.02
Log g	4.25	4.23	—
M bol (mag)	4.35	4.45	—
Mass ratio	0.9708		0.0084
Distance (pc)	235		—

Acknowledgements
It is a pleasure to thank the staff members at the DAO (especially Les Saddlemyer) for their usual splendid help and assistance. Thanks are also due to Environment Canada for the website satellite images (see 'Satellite images' below) that were essential in predicting clear times for observing runs in this cloudy locale and to Attilla Danko for his Clear Sky Clocks, (see below).

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AN ECLIPSING NEAR CONTACT SHORT PERIOD BINARY IN THE FIELD OF FS Aur

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Name of the object:
HH95-79

Equatorial coordinates:	**Equinox:**
R.A.= $05^h48^m03\overset{s}{.}85$ **DEC.=** $28^\circ30'47\overset{''}{.}6$	J2000

Observatory and telescope:
RoboScope 0.41 meter, Whispering Pines 0.3 meter, UCA Observatory 0.28 meter, and Nubbin Ridge Observatory 0.35 meter

Detector:	[1]Liquid nitrogen cooled, thinned CCD, 512x512 pixels, each pixel 24 microns, [2]SBIG ST-6, [3,4]Apogee KX-1

Filter(s):	BVR

Date(s) of the observation(s):
(Roboscope) 185 nights between UTD 040202 and 991018, (Arkansas Observatories) 25 nights between UTD 031120 and 040201

Transformed to a standard system:	no
Standard stars (field) used:	

Type of variability:	Eclipsing

Remarks:

HH95-79 is a star near the cataclysmic variable (CV) FS Aur. A finding chart generated with Aladin software (Bonnarel et.al., 2000) is shown in Figure 1. HH95-79 was initially calibrated as a secondary standard star for the field of FS Aur (Henden and Honeycutt, 1995) as the CV is a part of the Indiana University RoboScope program (Honeycutt and Turner, 1992). The inhomogeneous ensemble photometry (Honeycutt, 1992) used on the RoboScope database, can yield the light curve for every star in the field of interest. The variability of HH95-79 was suggested by the 0.2 sigma uncertainty in its instrumental magnitude as seen in Figure 2. A period search of the RoboScope data using the method of Horne and Baliunas, (1986) revealed an eclipsing binary system with a period of 0.2508 days. We obtained differential time-series BVR photometry during 2003 of this field variable using an ensemble of observatories in Arkansas. Comparison stars used were HH95-62, HH95-63, and HH95-61 (Henden and Honeycutt, 1995). The time of minimum light was determined using the R-band data on UTD 031120 via the method of Kwee and van Woerden, (1956). B-band, V-band, and R-band differential light curves are shown in Figure 3 using the ephemeris

$$T_{\min} = 2452963.744(4) + 0.2508(1) \times E$$

Preliminary binary star models indicate that this system has a mass ratio of about 0.519, a primary temperature of about 4500 K, a secondary temperature of about 3585K, an inclination angle of about 83 degrees, and a filling factor of about 3% overfilling. Therefore, this appears to be a close binary system either in near contact or just barely in contact.

Acknowledgements:

We thank Arne Henden for his original USNO observations used to calibrate the FS Aur standards.

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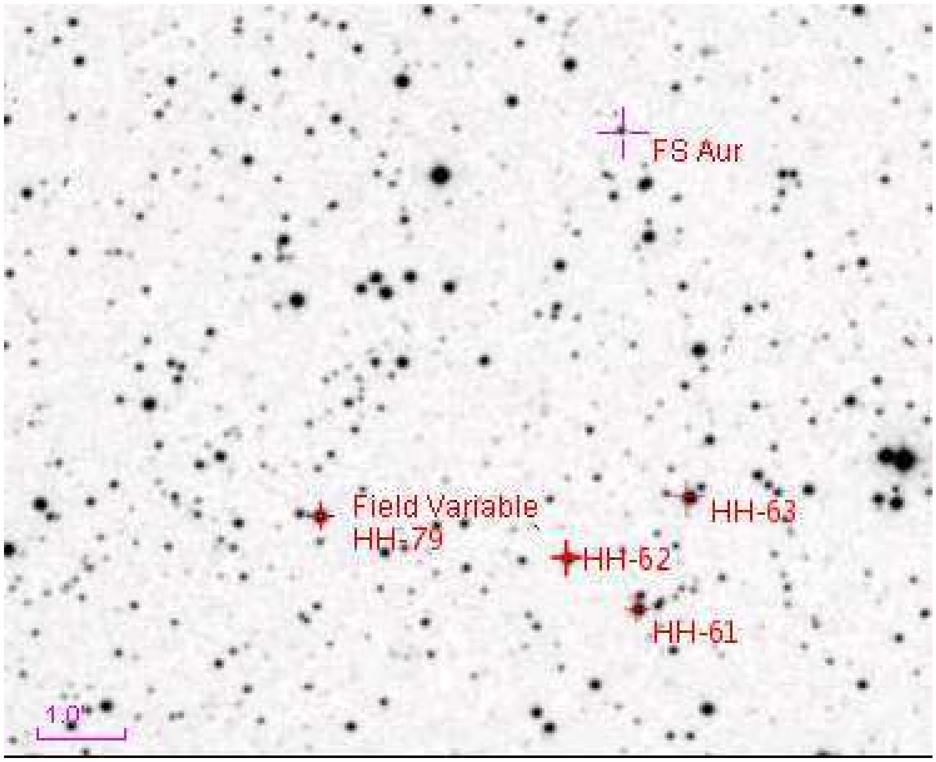

Figure 1. Finding chart.

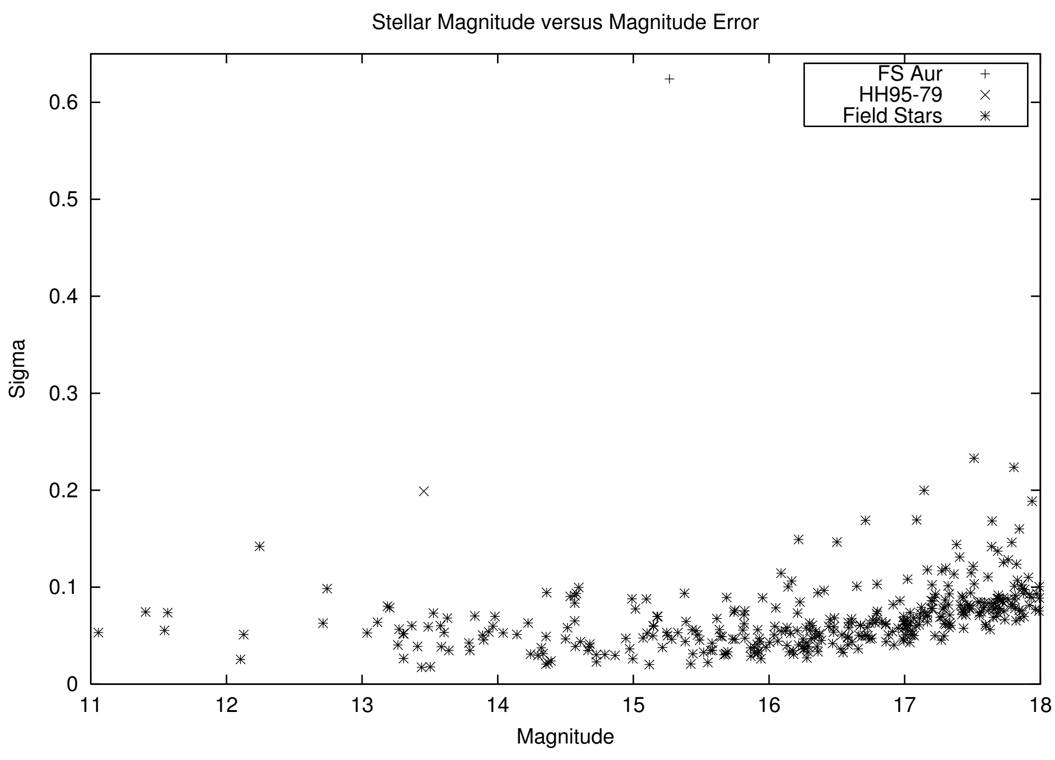

Figure 2. The inhomogeneous ensemble photometry SIGMA shows FS Aur with a sigma around 0.6 and HH95-79 with a sigma of about 0.2.

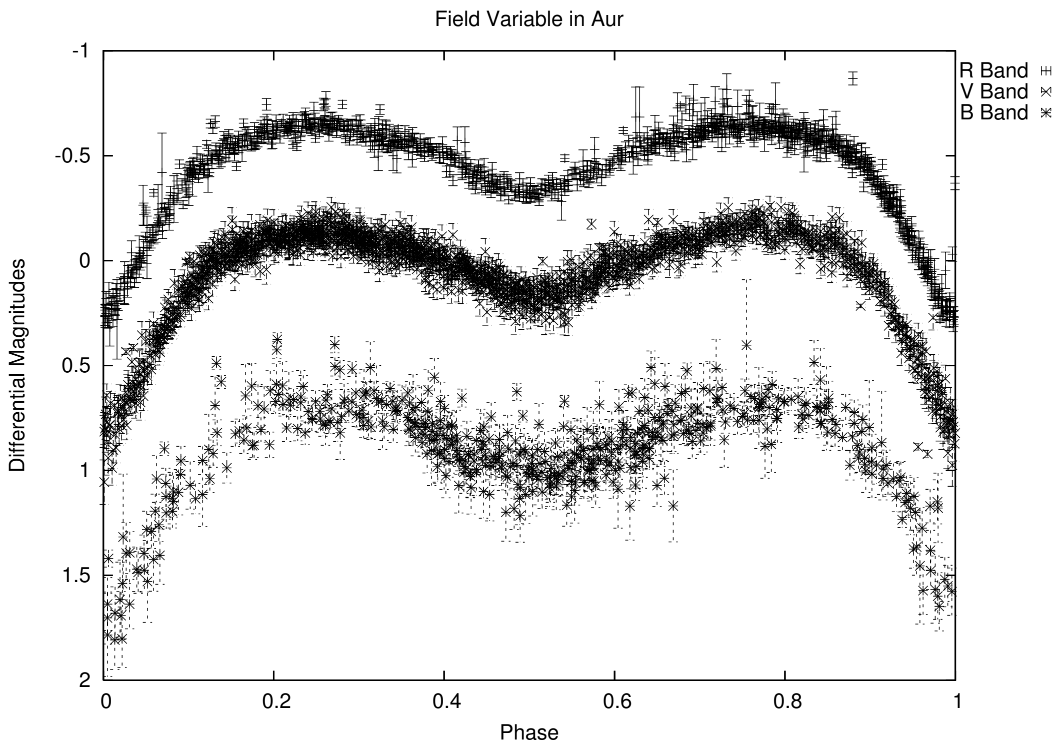

Figure 3. BVR differential photometry of HH95-79

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DISCOVERY OF SHORT-PERIODIC PULSATING COMPONENTS IN ALGOL-TYPE ECLIPSING BINARY SYSTEMS EF Her AND CT Her

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Observatory and telescope:
Sobaeksan Optical Astronomy Observatory in Korea, 61cm telescope for EF Her; Mt. Lemmon Optical Astronomy Observatory in USA, 1.0m telescope for CT Her

Detector:	2K CCD camera installed at each site

Filter(s):	Johnson B

Transformed to a standard system:	No

Availability of the data:
Upon request

Method of data reduction:
Standard CCD-frame reduction using the IRAF/DAOPHOT[1] package.

Remarks:
We have been performing a photometric survey to search for A-type pulsating components in eclipsing binary systems from September 2001 onwards at Sobaeksan Optical Astronomy Observatory (SOAO, Kim et al. 2003). Several observing targets were also monitored in March 2004 using a 1.0m telescope at Mt. Lemmon Optical Astronomy Observatory (LOAO), Arizona, USA; (Korea Astronomy Observatory has installed the telescope in September 2003). We report here a recent discovery of two new pulsating components in Algol-type semi-detached eclipsing binary systems EF Her and CT Her.

[1]IRAF is distributed by the National Optical Astronomy Observatories, which are operated by the Association of Universities for Research in Astronomy, Inc., under cooperative agreement with the National Science Foundation.

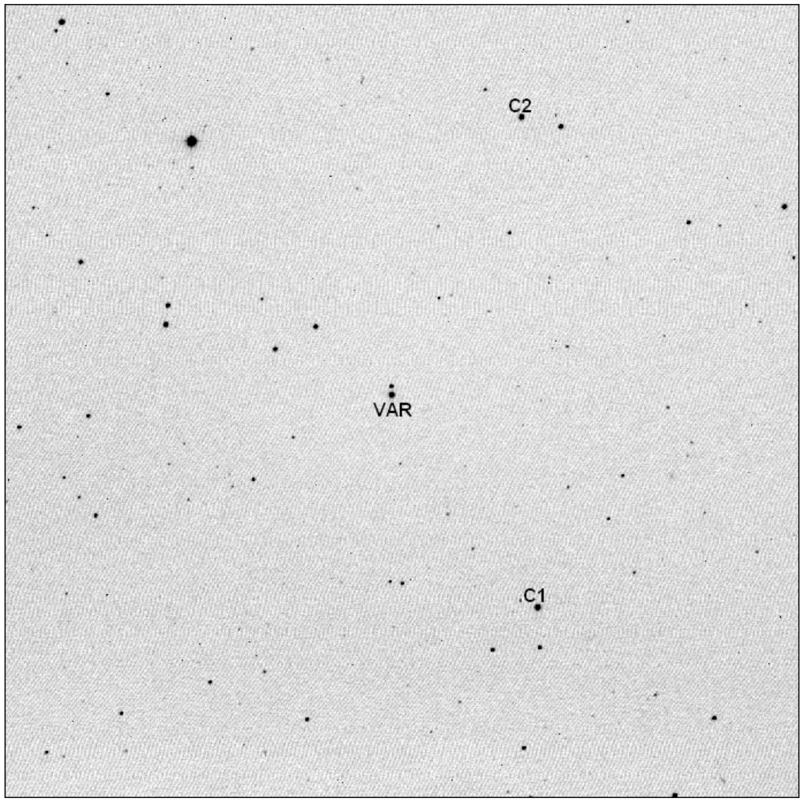

Figure 1. A B-band CCD image ($20\farcm5\times20\farcm5$) near the eclipsing binary EF Her (VAR) obtained with the SOAO 61cm telescope and 2K CCD camera. The comparison (C1) and check stars (C2) are marked. North is up and east is to the left

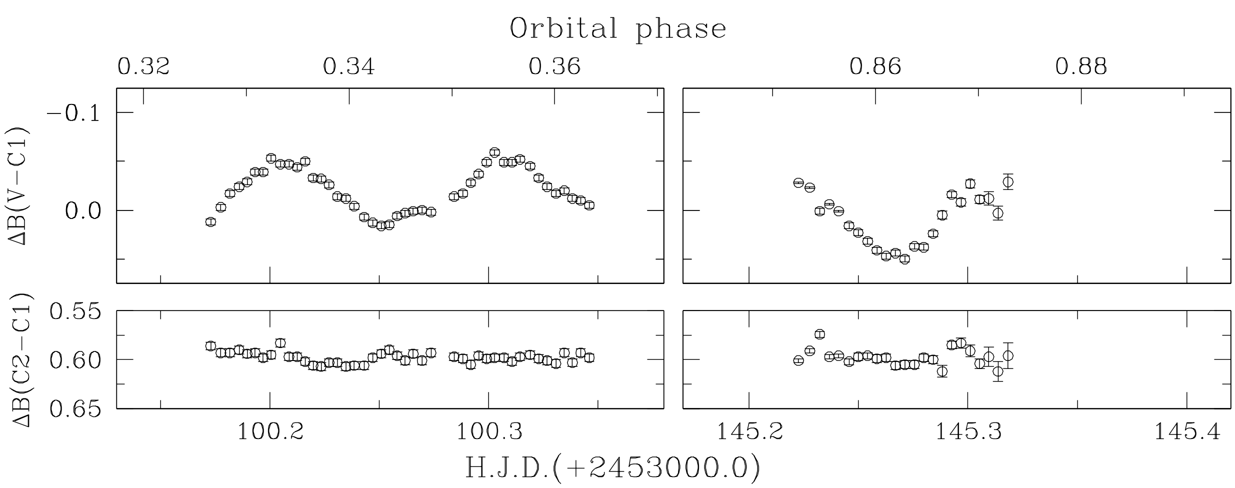

Figure 2. Differential magnitudes between the variable star EF Her and its comparison star, ΔB(V$-$C1). Observation data of the check star, ΔB(C2$-$C1), are also displayed at lower panel for comparison.

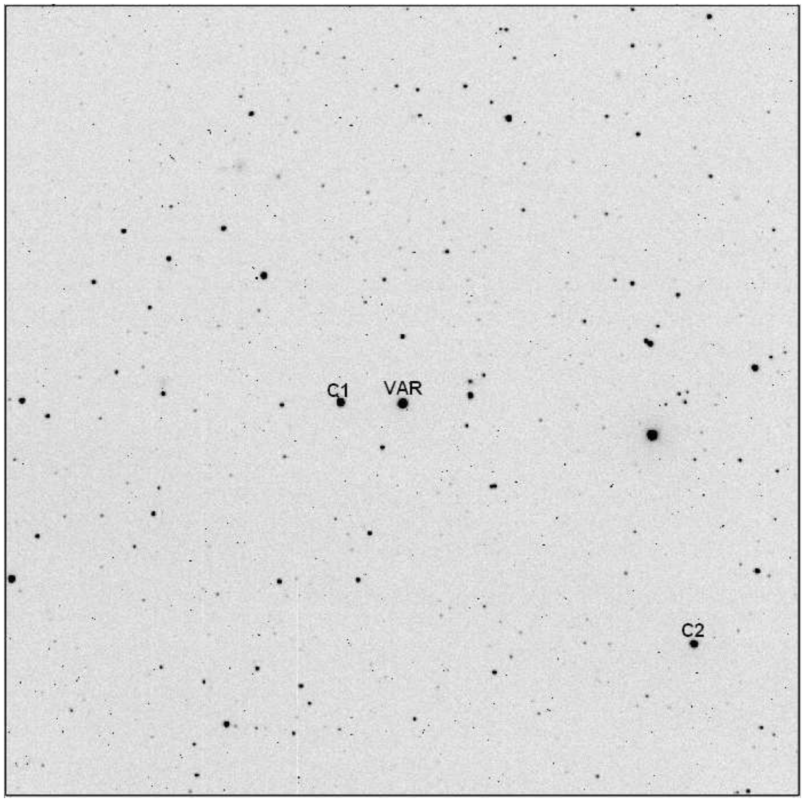

Figure 3. A B-band CCD image ($22'.2\times22'.2$) near the eclipsing binary CT Her (VAR) obtained with the LOAO 1.0m telescope and 2K CCD camera. The comparison (C1) and check stars (C2) are marked. North is up and east is to the left

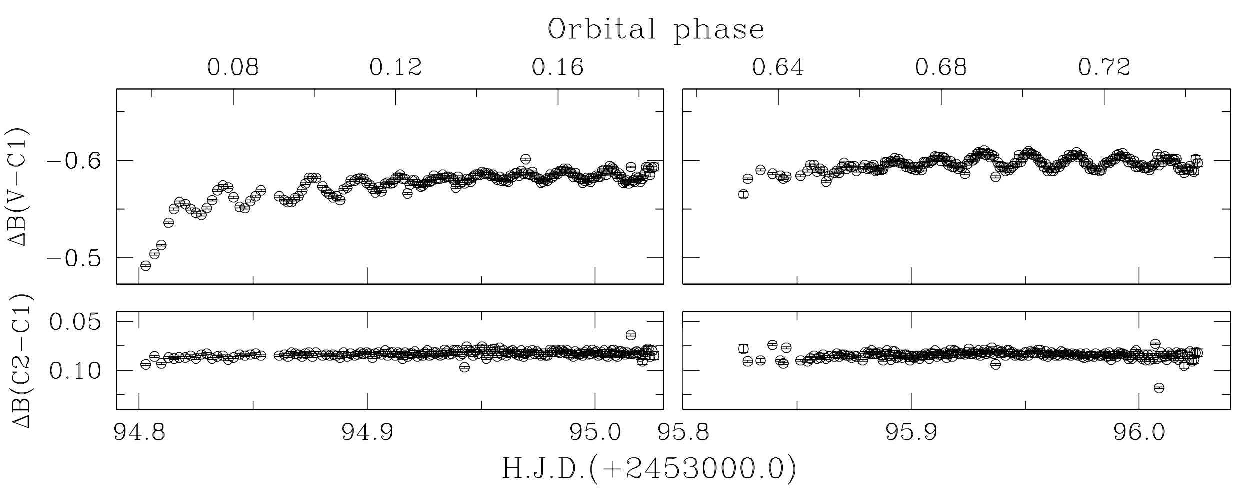

Figure 4. Differential magnitudes between the variable star CT Her and its comparison star, ΔB(V−C1). Observation data of the check star, ΔB(C2−C1), are also displayed at lower panel for comparison.

Table 1. Photometric parameters of observing stars from the Tycho-2 catalogue

ID	Name	RA (J2000)	DEC (J2000)	V_T	$(B_T{-}V_T)$
VAR	EF Her	$16^h55^m26\overset{s}{.}10$	$+17°17'47\overset{''}{.}8$	$11\overset{m}{.}596$	$0\overset{m}{.}601$
C1	GSC 01525-01000	$16^h55^m10\overset{s}{.}75$	$+17°12'26\overset{''}{.}0$	$11\overset{m}{.}189$	$1\overset{m}{.}093$
C2	GSC 01525-01242	$16^h55^m12\overset{s}{.}31$	$+17°24'46\overset{''}{.}7$	$12\overset{m}{.}031$	$0\overset{m}{.}673$
VAR	CT Her	$16^h20^m26\overset{s}{.}57$	$+18°27'16\overset{''}{.}9$	$11\overset{m}{.}347$	$0\overset{m}{.}203$
C1	GSC 01509-01140	$16^h20^m33\overset{s}{.}89$	$+18°27'18\overset{''}{.}5$	$10\overset{m}{.}951$	$1\overset{m}{.}414$
C2	GSC 01509-01052	$16^h19^m52\overset{s}{.}30$	$+18°20'32\overset{''}{.}9$	$11\overset{m}{.}405$	$0\overset{m}{.}779$

Remarks:

We applied simple aperture photometry to get instrumental magnitudes with an aperture radius of 10 pixels, that is, $6\overset{''}{.}0$ for the SOAO 61cm telescope (EF Her) and $6\overset{''}{.}4$ for the LOAO 1.0m telescope (CT Her). The seeing was between $2\overset{''}{.}3$ and $3\overset{''}{.}3$ during the observing runs in the two sites. Figures 1 and 3 display sample CCD images of EF Her and CT Her, respectively. There is a faint star near EF Her to the north, but it is about 13 arcsec from EF Her so our measurements were not affected by it. Comparison stars for each variable star did not show any peculiar light variation during our runs, examining with several check stars in the images. Differential magnitudes of EF Her and CT Her are shown in Figures 2 and 4, respectively. Orbital phases were calculated from the orbital period and epoch given in the GCVS catalogue (Kholopov et al. 1988).

We found short-period light variations of EF Her and CT Her, not originated from the eclipsing phenomena. The eclipsing binary EF Her, spectral type of A, has a primary component which shows δ Scuti-type pulsations with a period of about $2\overset{h}{.}5$ and an amplitude of about $0\overset{m}{.}06$. The primary component of CT Her shows also δ Scuti-type pulsations with a period of about $0\overset{h}{.}46$ and a maximum amplitude of about $0\overset{m}{.}03$. It also shows light curve modulation, suggesting multiple periods. CT Her is a very interesting object because its physical characteristics such as its semi-detached configuration, early A spectral type, very short-period of about 28 minutes and multi-periodicity, are very similar to the well-known oEA (oscillating EA) stars, RZ Cas (Rodríguez et al. 2004) and AS Eri (Mkrtichian et al. 2004). We suggest that EF Her and CT Her are new members of the recently formed group of mass-accreting pulsating components in Algol-type semi-detached eclipsing binary systems (oEA stars; Mkrtichian et al. 2004). Thus the number of oEA stars has increased to ten.

Acknowledgements:

This research made use of the SIMBAD database, operated at CDS, Strasbourg, France

Reference:

Kholopov, P.N., Samus, N.N., Frolov, M.S., et al., 1988, in *General Catalogue of Variable Stars*, 4th Edition (Moscow: Nauka Publishing House)
Kim, S.-L., Lee, J.W., Kwon, S.-G., et al., C., 2003, *A&A*, **405**, 231
Mkrtichian, D.E., Kusakin, A.V., Rodríguez, E., et al., 2004, *A&A*, **419**, 1015
Rodríguez, E., García, J.M., Mkrtichian, D.E., et al., 2004, *MNRAS*, **347**, 1317

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DISCOVERY OF A SHORT-PERIODIC PULSATING COMPONENT IN THE ALGOL-TYPE ECLIPSING BINARY SYSTEM AO Ser

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Observatory and telescope:
Mt. Lemmon Optical Astronomy Observatory in USA, 1.0m telescope

Detector:	2K CCD camera

Filter(s):	Johnson B

Transformed to a standard system:	No

Availability of the data:
Upon request

Method of data reduction:
Standard CCD-frame reduction using the IRAF/DAOPHOT[1] package.

Table 1. Photometric parameters of observing stars from the Tycho-2 catalogue

ID	Name	RA (J2000)	DEC (J2000)	V_T	$(B_T - V_T)$
VAR	AO Ser	$15^h58^m18\overset{s}{.}41$	$+17°16'10\overset{''}{.}0$	$11\overset{m}{.}064$	$0\overset{m}{.}242$
C1	GSC 01496-01071	$15^h58^m19\overset{s}{.}91$	$+17°19'45\overset{''}{.}4$	$11\overset{m}{.}682$	$0\overset{m}{.}836$
C2	GSC 01496-00063	$15^h58^m13\overset{s}{.}00$	$+17°16'42\overset{''}{.}5$	$11\overset{m}{.}864$	$0\overset{m}{.}516$

[1]IRAF is distributed by the National Optical Astronomy Observatories, which are operated by the Association of Universities for Research in Astronomy, Inc., under cooperative agreement with the National Science Foundation.

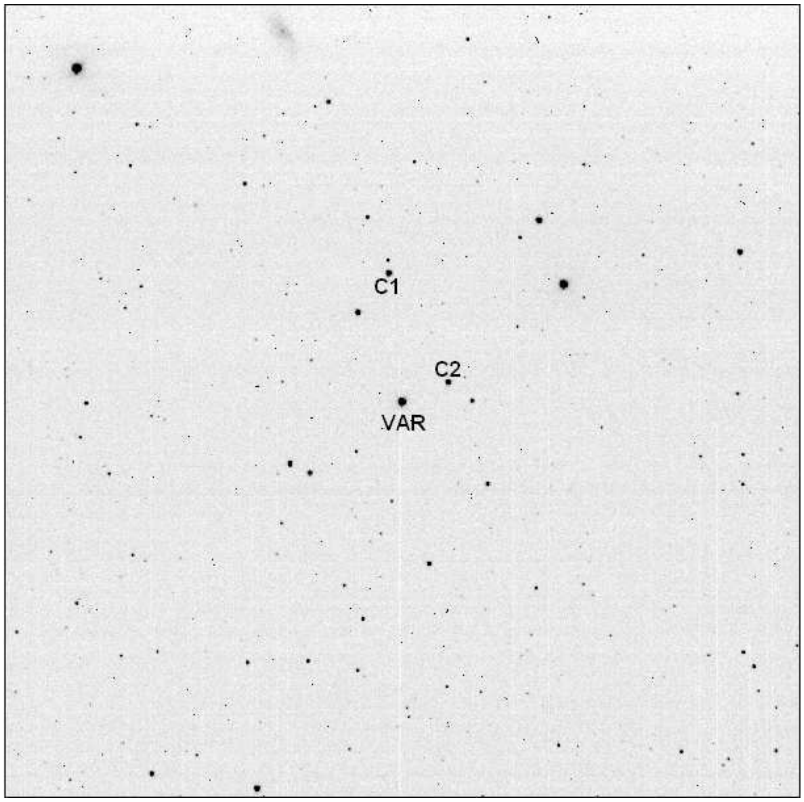

Figure 1. A B-band CCD image ($22.\!'2 \times 22.\!'2$) near the eclipsing binary AO Ser (VAR) obtained with the LOAO 1.0m telescope and 2K CCD camera. The comparison (C1) and check stars (C2) are marked. North is up and east is to the left

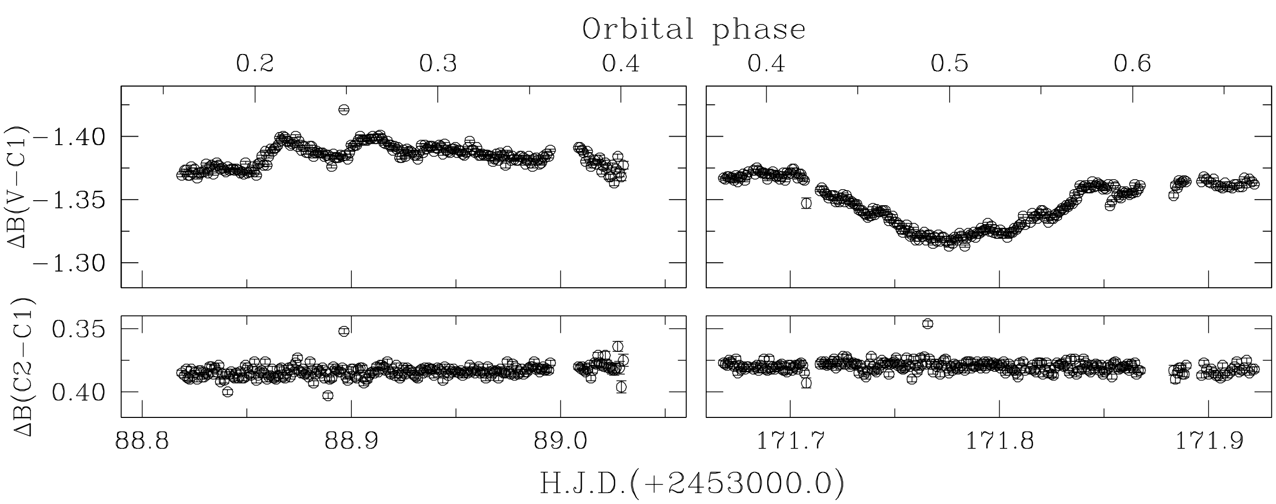

Figure 2. Differential magnitudes between the variable star AO Ser and the comparison star, ΔB(V−C1). Observation data of the check star, ΔB(C2−C1), are also displayed at lower panel for comparison.

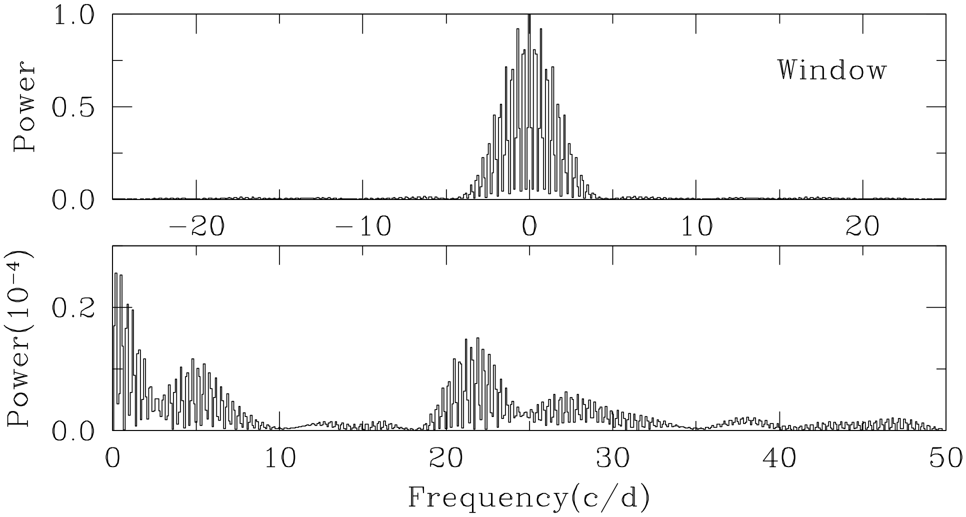

Figure 3. Power spectra of the residuals after subtracting a synthetic eclipsing light curve from the data. The window spectrum is displayed in the top panel. We could detect a peak near 21.5 cycles per day (c/d) in the lower panel. Low-frequency peaks less than 6.0 c/d might be originated from the incomplete synthetic curve.

Remarks:

As a part of our photometric survey project to search for A-type pulsating components in eclipsing binary systems (Kim et al. 2003), we monitored several observing targets in March 2004 using a 1.0m telescope at Mt. Lemmon Optical Astronomy Observatory (LOAO), Arizona, USA (Korea Astronomy Observatory has installed the telescope in September 2003). From these observations, we found small-amplitude short-periodic oscillations of AO Ser and then performed follow-up observations to confirm the variations in June 2004.

Simple aperture photometry was applied to get instrumental magnitudes with an aperture radius of 10 pixels (=$6''\!.4$); seeing size was about $3''\!.0$ during the observing runs. Figure 1 displays a sample CCD image of AO Ser. A comparison star, GSC 01496-01071, did not show any peculiar light variation during the runs, examining with several check stars in a CCD image. Differential magnitudes of AO Ser are shown in Figure 2. Orbital phases were calculated from the orbital period and epoch from the GCVS catalogue (Kholopov et al. 1988).

In addition to slow light variations caused by the eclipsing phenomenon, the data show oscillations with short-period less than 0.05 days and small-amplitude of maximum $\Delta B \sim 0^{m}\!.02$. The oscillations show amplitude modulation, implying to have multiple periods. We calculated residuals subtracting a synthetic eclipsing light curve from the data; the synthetic curve was derived from the 1998-version of Wilson & Devinney (1971) code. Power spectra of the residuals show clearly a peak near 21.5 cycles per day (=$1^{h}\!.116$, Figure 3). Considering the δ Scuti-type pulsation characteristics (period, amplitude and spectral type of A2) and semi-detached configuration, we suggest that AO Ser is a new member of a recently formed group of mass-accreting pulsating components in Algol-type semi-detached eclipsing binary systems (oEA stars; Mkrtichian et al. 2004). Then the number of oEA stars has increased eleven, including our recent discovery of two oEA stars EF Her and CT Her (Kim et al. 2004).

Acknowledgements:

This research made use of the SIMBAD database, operated at CDS, Strasbourg, France

Reference:

Kholopov, P.N., Samus, N.N., Frolov, M.S., et al., 1988, in *General Catalogue of Variable Stars*, 4th Edition (Moscow: Nauka Publishing House)

Kim, S.-L., Lee, J.W., Kwon, S.-G., et al., C., 2003, *A&A*, **405**, 231

Kim, S.-L., Koo, J.-R., Lee, J.A., et al., 2004, *IBVS*, No. 5537

Mkrtichian, D.E., Kusakin, A.V., Rodríguez, E., et al., 2004, *A&A*, **419**, 1015

Wilson, R.E., Devinney, E.J., 1971, *ApJ*, **166**, 605

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FOUR RR LYRAE STARS WITH VARIABLE PERIODS IN OPHIUCHUS

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Hoffmeister (1967) has reported the discovery of the RR Lyr stars analysed in the present paper. No ephemerides were published for V1097 Oph and V2029 Oph until today and, in the other cases, period variations were detected as a result of our observations. Photographic plates of a field centered around 67 Oph, taken with the Sonneberg Observatory 40cm Astrograph during three intervals spread over the years from 1938−1994, were used to check the behaviour of these objects (see Table 1). The elements listed below were obtained by means of least-squares solutions. Already published times of maxima for V1077 Oph and V1090 Oph (Ivanij and Samus, 1994, and Konoplyov, 1986) were included in these solutions.

Photographic amplitudes were derived with respect to magnitudes of the comparison stars given in Table 2. Individual data are available upon request.

Remarks:

V1077 Oph

A first and somewhat preliminary set of elements consisting of 3 slightly different periods derived from observations covering only about 2000 days was published by Konoplyov (1986). The light curves in this paper show considerable scatter especially between phases 0.3 and 0.8. The observations reported here allow to confirm in principle the value of the period and have ascertained a major period change occurred around J.D. 2441500. Elements listed in Table 1 are valid for J.D. 2429100−2439600 and J.D. 2442900−2449500, resp.

V1090 Oph

Although a precise time of the period change can not be clearly deduced from the (O−C)-diagram, the composite light curve drawn with these period values gives some hints to assume a period change took place around J.D. 2438500. Elements are at least valid for J.D. 2429100−2431700 and J.D. 2438200−2449500, resp.

V1097 Oph

A similar situation applies to V1097 Oph. Our elements given below are at least valid for the intervals of JD 2429100−2431700 and J.D. 2438200−2449500. Unfortunately there were no plates available in between these times. So, the (O–C)-diagram represents only one reasonable version of the stars period history.

V2029 Oph

Only observations from J.D. 2438258−2449488 were displayed in the light curve because of the uncertainties concerning the set of elements valid prior to this date. The given ephemeris is valid for J.D. 2438900−2449200.

Table 1. Summary of this paper

Star	Type	Epoch 2400000+	Period (day)	Max.	Min.	M−m	No. of Plates
V1077 Oph (1)	RRab	39259.556 ±15	0.3739892 ±8	$15\overset{\mathrm{m}}{.}2$	$15\overset{\mathrm{m}}{.}9$	$0\overset{\mathrm{P}}{.}18$	58
V1077 Oph (2)		48100.422 ±6	0.3739738 ±6				67
V1090 Oph (1)	RRab	38528.505 ±12	0.5266866 ±10	$14\overset{\mathrm{m}}{.}9$	$>15\overset{\mathrm{m}}{.}6$	$0\overset{\mathrm{P}}{.}15$	41
V1090 Oph (2)		43933.604 ±4	0.5266592 ±10				74
V1097 Oph (1)	RRab	29790.437 ±8	0.5927486 ±3	$14\overset{\mathrm{m}}{.}8$	$16\overset{\mathrm{m}}{.}4$	$0\overset{\mathrm{P}}{.}20$	132
V1097 Oph (2)		47770.340 ±6	0.5927533 ±8				42
V2029 Oph	RRab	49154.467 ±12	0.5900729 ±11	$14\overset{\mathrm{m}}{.}9$	$15\overset{\mathrm{m}}{.}5$	$0\overset{\mathrm{P}}{.}13$	114

Table 2. Comparison stars and cross references

	V1077 Oph S 9843 USNO 0900-10764128		V1090 Oph S 9863 USNO 0975-10473162	
Comp. No.	USNO	m*	USNO	m*
1	0900-10762796	$15\overset{\mathrm{m}}{.}3$	0975-10468047	$14\overset{\mathrm{m}}{.}7$
2	0900-10758477	$15\overset{\mathrm{m}}{.}6$	0975-10481309	$15\overset{\mathrm{m}}{.}0$
3	0900-10756678	$15\overset{\mathrm{m}}{.}8$	0975-10473364	$15\overset{\mathrm{m}}{.}2$
4	0900-10759166	$16\overset{\mathrm{m}}{.}1$	0975-10476690	$15\overset{\mathrm{m}}{.}7$

	V1097 Oph S 9874 USNO 0900-12237409		V2029 Oph S 9846 USNO 0900-10886697	
Comp. No.	USNO	m*	USNO	m*
1	0900-12236119	$14\overset{\mathrm{m}}{.}5$	0900-10893744	$14\overset{\mathrm{m}}{.}6$
2	0900-12237108	$15\overset{\mathrm{m}}{.}2$	0900-10891766	$15\overset{\mathrm{m}}{.}0$
3	0900-12241628	$15\overset{\mathrm{m}}{.}7$	0900-10892260	$15\overset{\mathrm{m}}{.}3$
4	0900-12240377	$16\overset{\mathrm{m}}{.}4$		

* Magnitudes refer to the B values of the USNO−A2.0 catalogue

This research made use of the SIMBAD data base, operated by the CDS at Strasbourg, France.

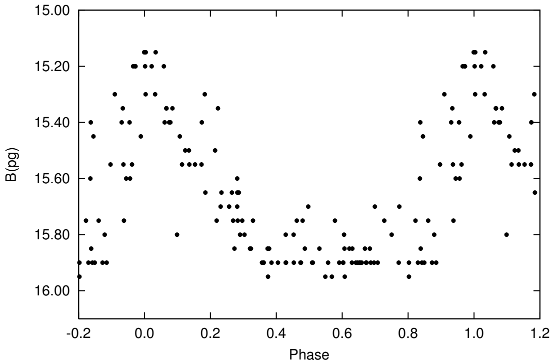

Figure 1. Composite light curve of V1077 Oph

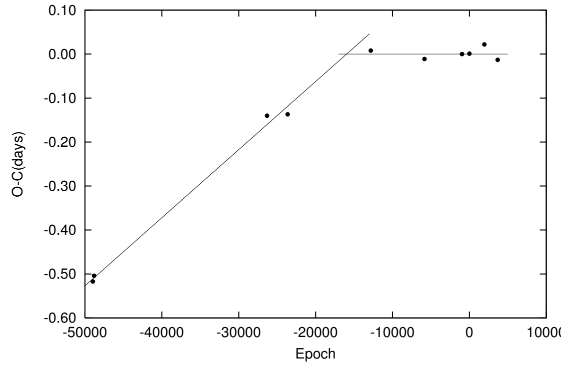

Figure 2. (O−C) diagram for V1077 Oph

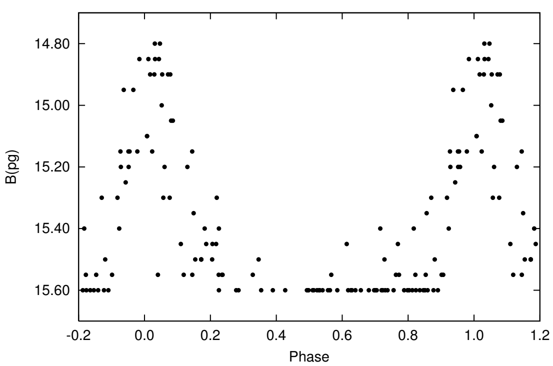

Figure 3. Composite light curve of V1090 Oph

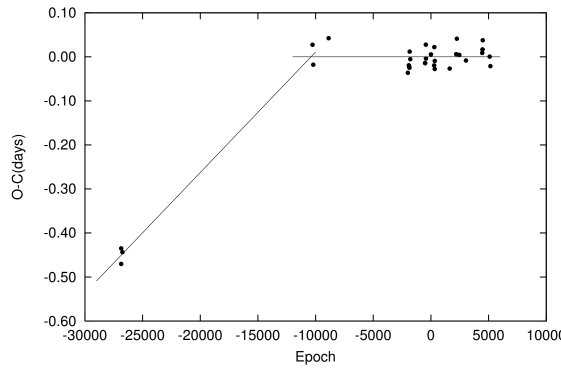

Figure 4. (O−C) diagram for V1090 Oph

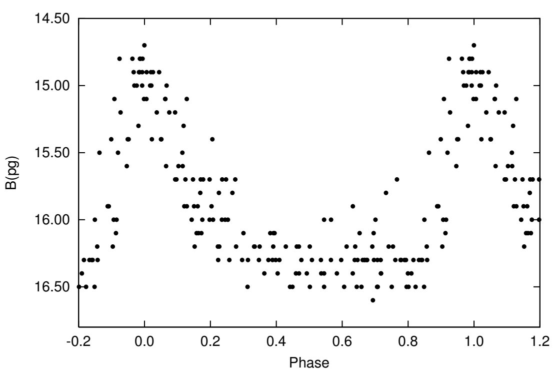

Figure 5. Composite light curve of V1097 Oph

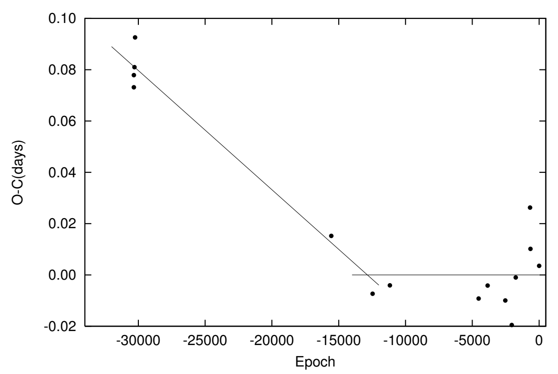

Figure 6. (O−C) diagram for V1097 Oph

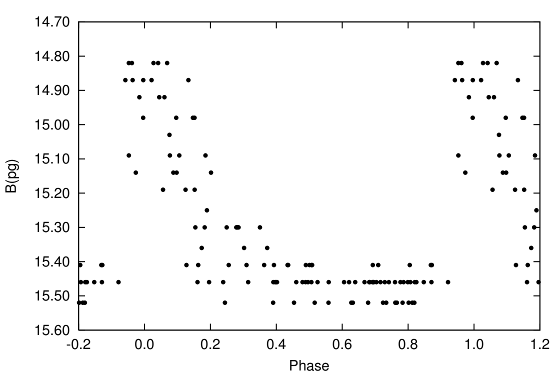

Figure 7. Light curve (J.D. 2438258 − 2449488) of V2029 Oph

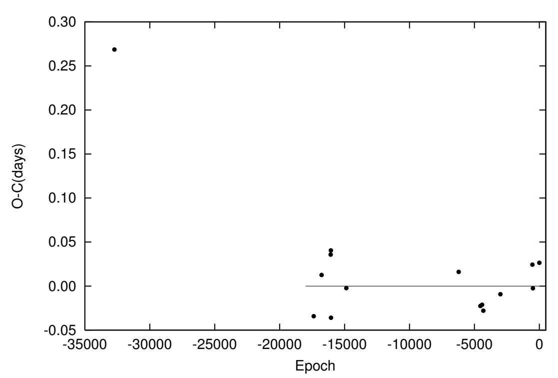

Figure 8. (O−C) diagram for V2029 Oph

Table 3. Heliocentric times of new found maxima and $O-C$ values according to the elements derived in this paper

Star	JD (max.*)	Epoch	$O-C$	Star	JD (max.*)	Epoch	$O-C$
V1077 Oph (1)	29786.410	−25330	0.001	V1097 Oph (1)	38549.486	14777	0.002
	29844.389	−25175	0.012		40383.442	17871	−0.006
	38258.415	−2677	0.028		41150.468	19165	0.003
	39259.546	0	−0.010	V1097 Oph (2)	45087.530	−4526	−0.011
V1077 Oph (2)	43303.469	−12827	0.008		45486.458	−3853	−0.004
	45916.405	−5840	−0.011		46272.443	−2527	−0.006
	47744.399	−952	0.000		46554.584	−2051	−0.014
	48100.423	0	0.001		46731.243	−1753	0.005
	48830.441	1952	0.022		47368.480	−678	0.035
	49475.511	3677	−0.013		47387.432	−646	0.019
V1090 Oph (1)	29785.522	−16600	0.016		47770.344	0	0.015
	29786.540	−16598	−0.020	V2029 Oph	29843.418	−32727	0.269
	29843.446	−16490	0.004		38902.505	−17374	−0.034
	38528.528	0	0.023		39259.546	−16769	0.013
	38557.449	55	−0.023		39671.440	−16071	0.036
	39259.546	1388	0.000		39681.476	−16054	0.040
V1090 Oph (2)	45087.521	2191	0.006		39684.350	−16049	−0.036
	45115.469	2244	0.041		40382.440	−14866	−0.002
	45530.427	3032	−0.008		45492.490	−6206	0.016
	46272.507	4441	0.009		46476.693	−4538	−0.023
	46289.368	4473	0.017		46554.584	−4406	−0.021
	46290.421	4475	0.016		46609.454	−4313	−0.028
	46298.342	4490	0.038		47388.369	−2993	−0.009
V1097 Oph (1)	29787.470	−5	−0.003		48839.392	−534	0.024
	29790.429	0	−0.008		48862.378	−495	−0.002
	29816.518	44	0.000		49154.493	0	0.026
	29844.389	91	0.012				

* Mid-exposure times of plates with brightest observations

References:

Hoffmeister, C., 1967, *Astron. Nachr.*, **290**, 43
Ivanij, M. B., Samus, N. N. 1994, *Perem. Zvezdy*, **23**, 251
Konoplyov, P. I., 1986, *Perem. Zvezdy*, **22**, 417

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24 June 2004

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ABNORMAL COLOUR VARIATIONS OF THE CLASSICAL T TAURI STAR: SU Aur

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SU Aur is an Orion-type (Classical T Tauri) variable star of relatively later spectral type F5-G2 CIIIe. A histogram of V-magnitudes shows that the most time the star is bright. Sometimes the star brightness fades, amplitude of the Algol eclipse-like fadings reaching up to 1.5-2.0 of magnitude. The photometric properties of the star are properly described in a recent paper by DeWarf et al. (2003). The brightness fadings of Orion-type variables are most likely caused by circumstellar dust clouds orbiting or emerging near the star. While an Orion-type star is fading, the colour index $B-V$ increases and the star becomes "redder". The positive interrelation between the V-magnitude and colour index $B-V$ is a typical characteristic of the stars with Algol-like minima (except for deep minima where so-called "zodiacal light" (Grinin, 1988) appears). As for SU Aur, such a dependence found from our observations (Pugach, 1996), is shown in Fig.1.

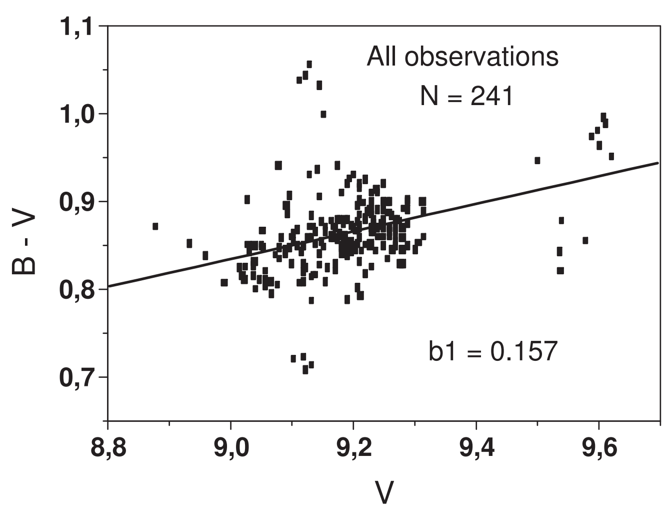

Figure 1. All observations of SU Aur obtained by the author during 1974 - 1985

An analysis of our observations of the star allowed us to identify a new type of photometric variability for SU Aur. Rapid, small amplitude brightness variations at maximum light are observed accompanied by a reverse $V-(B-V)$ relation. During this process

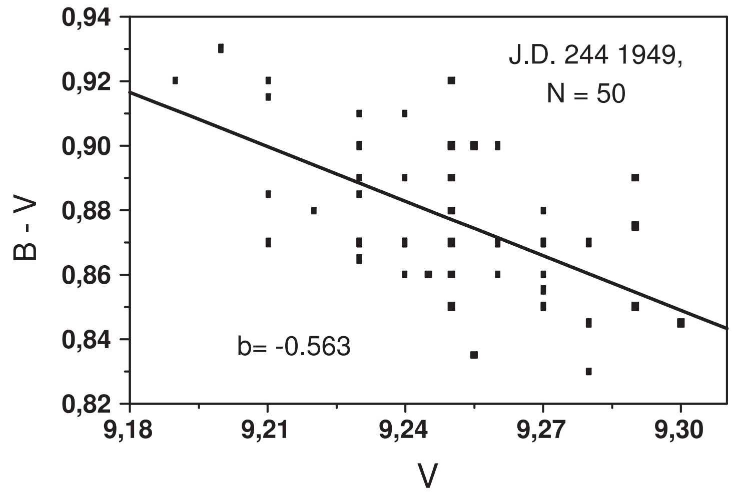

Figure 2. Abnormal $V-(B-V)$ relation for SU Aur. Observations were made at interval J.D. 244 1949.462 - ...1949.577

the colour index $B-V$ increases as the star becomes fainter. Our observations on J.D. 2441949, shown in Fig.2, support this contention. We refer to this effect as the "colour abnormality".

For this colour abnormality the coefficient b in the linear equation:

$$(B-V)=a+bV$$

always shows negative values. For all but one night of our observations when the number (n) of individual observations n≥5, the coefficients b shown in Table are negative.

J.D. 244 0000+	b	N	Δ m
...1949	-0.563±0.110	50	0.11
...1953	0.062±0.789	8	0.03
...1958	-0.620±0.724	6	0.02
...4152	-0.884±0.552	5	0.07
...4280	-0.162±0.109	30	0.09
...4281	-1.346±0.549	7	0.05
...5028	-0.311±0.688	6	0.033
...5033	-0.117±1.926	5	0.021

Photoelectric observations of SU Aur secured by others show similar behaviour. In Fig. 3, the results from the analysis of recent photometry of DeWarf et al. (2003) observations are shown. Although these observations were performed in the Strömgren photometric system, they may well be compared with our UBVR measurements as the effective wavelengths of photometric bands v and y of the Strömgren system are close to bands V and B of the $UBVR$ system. Statistical analysis of the data (DeWarf et al., 2003) reveals that the coefficient b is predominantly negative and has positive values only in 7 cases of 89 nights of observations analyzed, and in 3 cases it was close to zero.

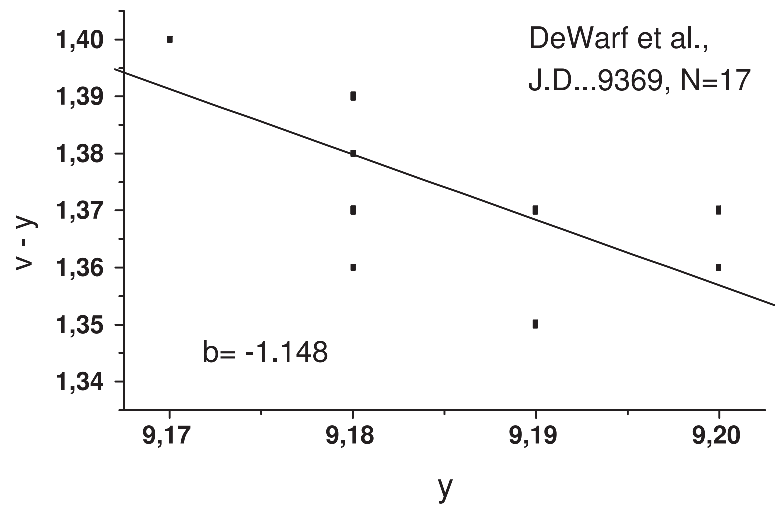

Figure 3. Abnormal colour relation found from the analysis of *uvby* observations of De Warf et al., 2003.

The abnormal colour variations considered are also evident from Zaitseva's (1968) observations (Fig. 4) and from the observations of Herbst et al. (1982) (Fig. 5).

SU Aur is the second related T Tauri variable star showing these abnormal colour variations. Identical abnormal colour variability was previously detected for the T Tau star BO Cep, when it was found to show similar photometric behaviour (Pugach, 2003). The analysis of the BO Cep photometry shows that the unknown agent causing the colour abnormality acts primarily in the photometric V-band. The behaviour of SU Aur is also consistent with this conclusion. Analysis of the SU Aur $UBVR$ observations (Herbst et al. 1982) shows that the colour index $V - R$ varies inversely as $B - V$ (Fig. 5). It's possible only if the abnormal colour variations originate from the changing the V-value solely. Thus, two similar stars BO Cep and SU Aur (considering their spectral and variability types) demonstrate the newly found colour variation abnormality. There is no obvious way to account for it neither by temperature variations nor by changes of the dust extinction. In addition, it is of special interest that the colour abnormality appears to result from changing the brightness of the star in the V band.

Reasons for such colour behaviour of SU Aur are now unknown. The simplest suggestion is that the colour abnormality reflects a process of mineral dust formation and subsequent dissipation.

Acknowledgements: I wish to thank Dr. DeWarf for his kind permission to use his unpublished observational material.

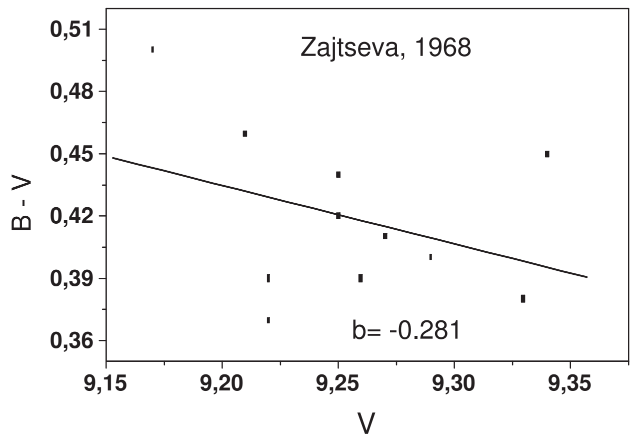

Figure 4. Abnormal colour relation from Zaitseva's observations (1968).

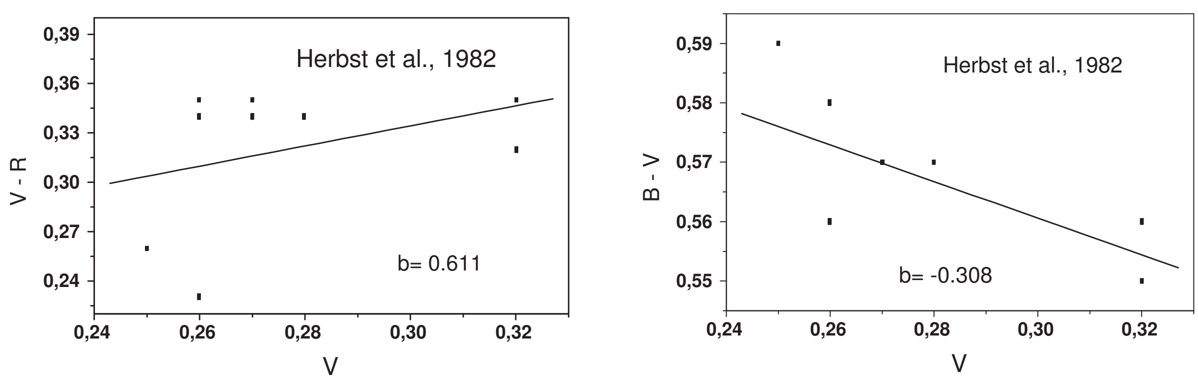

Figure 5. Data of Herbst et al. show that colour indexes $B-V$ and $V-R$ vary with opposite signs. It points out that radiation responsible for abnormal colour variability originates in the V band.

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DeWarf L.E., Sepinski J.F., Guinan E.F. et al., 2003, *ApJ*, **590**, 357
Grinin V.P., 1988, *Pisma v Astron. Zh.*, **14**, 65
Herbst W., Holtzman J.A., Phelps B.E., 1982, *AJ* **87**, 1710
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Budapest
5 July 2004

HU ISSN 0374 – 0676

CCD LIGHT CURVES OF ROTSE1 VARIABLES, XXII: GSC 2533:1519 CVn, GSC 2534:1121 CVn, GSC 2537:520 CVn AND GSC 2544:1007 CVn

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Observatory and telescope:
Private observatory Schüsselacher, Wald, 0.15-m Starfire refractor

Detector:	SBIG ST-7 CCD camera

Method of data reduction:
Standard CCD-frame reduction using AIP4WIN software

Method of minimum determination:
Kwee – van Woerden algorithm

Observed star(s):

Star name	GCVS type	Coordinates (J2000) RA	Dec	Comp./check star(s)
GSC 2533:1519				
ROTSE1 J124033.39+342255.8	EW	12 40 33.4	+34 22 56	GSC 2533:1553 / GSC 2533:1207
GSC 2534:1121				
ROTSE1 J130625.38+342917.7	EW	13 06 25.4	+34 29 18	GSC 2534:1056 / GSC 2534:1091
GSC 2537:520				
ROTSE1 J134117.73+315429.5	EB	13 41 17.7	+31 54 30	SAO 63685 / GSC 2537:909
GSC 2544:1007				
ROTSE1 J135313.76+322248.9	EW	13 53 13.8	+32 22 49	GSC 2544:976 / GSC 2544:1098

Ephemeris:

Star name	E 2400000+	P [day]	Source
ROTSE1 J124033.39+342255.8	53094.6168(13)	0.491421	present paper
ROTSE1 J130625.38+342917.7	53060.5691(9)	0.342687	”
ROTSE1 J134117.73+315429.5	53094.3741(8)	0.371039	”
ROTSE1 J135313.76+322248.9	53117.3815(8)	0.315367	”

Times of minima:						
Star name	Time of min. HJD 2400000+	Error	Type	Filter	$O-C$ [day]	Rem.
GSC2533:1519 (CVn)	51275.8649	7	p	none		ROTSE1
	51296.757	2	s	none		ROTSE1
	53045.4713	11	p	none		
	53060.4671	20	s	none		
	53060.706	3	p	none		
	53068.5686	8	p	none		
	53081.347	3	p	none		
	53094.3764	19	s	none		
	53094.6153	12	p	none		
	53117.4705	14	s	none		
GSC2534:1121 (CVn)	51244..6674	9	p	none		ROTSE1
	51338.7449	7	s	none		ROTSE1
	53045.4896	15	p	none		
	53060.3985	18	s	none		
	53060.5698	12	p	none		
	53068.4488	17	p	none		
	53081.4698	20	p	none		
	53094.3252	23	s	none		
	53094.4965	10	p	none		
	53117.4565	8	p	none		
	53117.6272	25	s	none		
GSC2537:520 (CVn)	51248.8222	8	p	none		ROTSE1
	51348.8239	15	s	none		ROTSE1
	53045.5866	18	s	none		
	53060.4205	10	s	none		
	53060.6083	12	p	none		
	53068.402	6	p	none		
	53068.5850	6	s	none		
	53081.3868	19	p	none		
	53094.3736	13	p	none		
	53094.5600	17	s	none		
	53117.3783	14	p	none		
	53117.5665	16	s	none		
GSC2544:1007 (CVn)	51251.8239	7	s	none		ROTSE1
	51259.872	5	p	none		ROTSE1
	53045.4760	9	p	none		
	53060.4579	13	s	none		
	53060.6181	20	p	none		
	53068.4984	18	p	none		
	53081.4294	19	p	none		
	53094.3569	12	p	none		
	53094.5212	21	s	none		
	53117.3811	17	p	none		
	53117.5393	11	s	none		

Explanation of the remarks in the table:
ROTSE1: Observations of Akerlof et al. (2000).

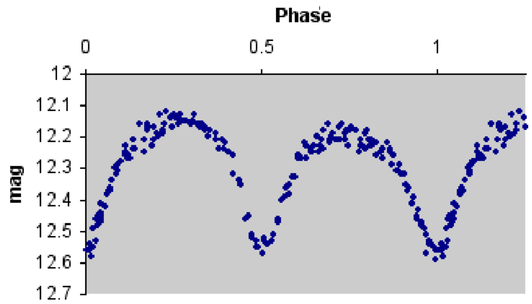

Figure 1. CCD light curve (without filter) of GSC 2533:1519

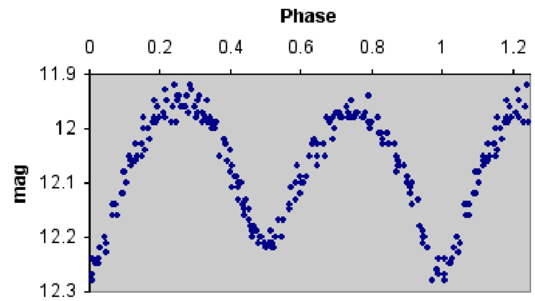

Figure 2. CCD light curve (without filter) of GSC 2534:1121

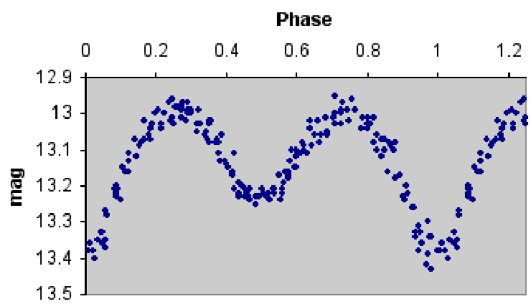

Figure 3. CCD light curve (without filter) of GSC 2537:520

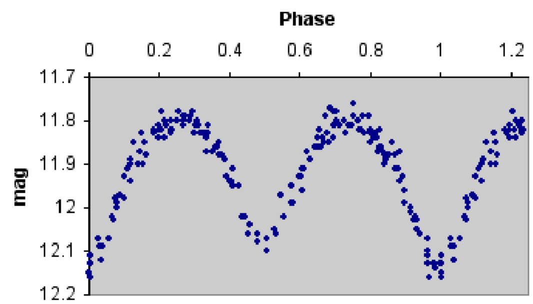

Figure 4. CCD light curve (without filter) of GSC 2544:1007

Remarks:
As a byproduct of the ROTSE1 CCD survey, a large number of new variables have been discovered (Akerlof et al., 2000). In a series of papers, we report unfiltered CCD observations for some of the close binary systems (type EW) in the list of Akerlof et al. (2000). This installment contains information on four variables in the constellation Canes Venatici. The four stars were observed with our CCD equipment during seven nights between JD 2453045 and JD 2453117. A total of 194 CCD frames were measured of GSC 2533:1519, 206 frames of GSC 2534:1121, 185 frames of GSC 2537:520 as well as 178 frames of GSC 2544:1007. Figures 1 through 4 show our observations folded with the elements given in the Table of Ephemeris. These elements of variation are deduced from a linear fit to the normal minima from the ROTSE1 data and the timings of minimum derived from our data given in the table of Times of minima.

Availability of the data:
Upon request from diethelm@astro.unibas.ch

Acknowledgements:
This research made use of the SIMBAD data base, operated at CDS, Strasbourg, France

Reference:

Akerlof, C., Amrose, S., Balsano, R., Bloch, J., Casperson, D., Fletcher, S., Gisler, G., Hills, J., Kehoe, R., Lee, B., Marshall, S., McKay, T., Pawl, A., Schaefer, J., Szymanski, J., Wren, J., 2000, *AJ*, **119**, 1901

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UPDATED ELEMENTS FOR SOUTHERN ECLIPSING BINARIES

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A set of 442 eclipsing binaries was selected from the GCVS catalog (Kholopov et al., 2003) that had declination < 0, minimum magnitude brighter than 13.0, and no published times of minima later than JD 2440000 available through the NASA ADS service. An automated web-based data gathering application was developed to retrieve and display data from the ASAS-3 database (Pojmanski, 2002). A search radius of 45 arcsec was used when selecting candidate stars.

Using the ASAS-3 data, a light curve for each star was plotted using the period listed in the GCVS. Only data of quality "A" or "B" were used in this analysis. Of the 442 stars, 281 were found to match the published periods quite well. For these stars updated times of minima were determined by picking the data point closest to the midpoint of the eclipse in the light curve plot. These updated times of minima are available in electronic form on the Konkoly Observatory IBVS site as `5542-t3.txt`.

The periods for an additional 46 stars were close to the published period, but were obviously not quite in phase. The data for these stars were analyzed using the interactive light curve plotting tool in AVE (Barberá, 1999). Many of these discrepancies probably represent real changes in periods over the intervening decades. The revised periods and times of minima determined as above are listed in Table 1, and are also available electronically at IBVS web site as `5542-t1.txt`.

Another 85 stars in the set had a period radically different from that listed in the GCVS. The period-searching routines in AVE were used on these stars to determine the correct period. The new periods and times of minima for these stars are listed in Table 2, and again also available on the IBVS web site as `5542-t2.txt`.

The remaining 30 stars were either not found in the ASAS database, despite an extended search radius, or were variables that had been misclassified as eclipsing binaries. A second paper is in preparation for the data on these stars.

Table 1. Updated elements for 46 eclipsing binary stars.

	GCVS		Updated		ASAS-3 (V mag)	
Star Name	Range	Period(d)	Period(d)	Epoch	Pri Range	Sec Range
WZ Ant	11.5-11.8	0.445854	0.44592	3044.76	11.7-12.1	11.7-12.0
HL Aps	12.3-12.9	0.956	0.956256	2512.512	12.5-13.0	12.5-12.9
II Aps	11.2-11.7	0.8424	0.84227	1930.843	11.0-11.5	11.0-11.5
LR Ara	10.0-10.6	1.519304	1.51955	2935.535	10.5-11.0	10.5-11.0
V0489 Ara	11.7-12.9	0.64	0.6401	3080.878	12.2-12.8	12.2-12.3
V0491 Ara	11.7-12.5	0.9404	0.9401	2437.635	12.3-12.9	12.3-12.5
DK Car	11.6-12.7	11.335	11.352	2463.8	11.9-12.8	11.9-12.0
PX Car	9.65-10.45	0.795171	0.7951	2910.82	9.6-10.4	9.6-10.0
LW Cen*	8.9-9.65	1.0025674	1.00265	2651.793	9.20-9.25	9.20-9.23
V0380 Cen	9.7-10.2	1.0872172	1.0872	3043.821	9.4-10.0	9.4-9.8
V0677 Cen	11.5-11.7	0.325067	0.325032	1921.83	10.8-11.2	10.8-11.2
VW CMa	9.0-9.2	0.720831	0.720815	2745.585	9.4-9.8	9.4-9.7
YY CMa	12.3-12.7	5.60945	5.612	2128.927	10.9-11.3	$<$ 0.1
RZ Col	11.0-11.58	0.56522725	0.56519	2116.908	11.0-11.5	11.0-11.2
UU CrA	10.9-11.6	2.237996	2.2376	2939.57	10.7-11.4	$<$ 0.1
SZ Cru	10.9-11.6	1.974	1.9743	3075.715	11.4-12.4	$<$ 0.1
TU Cru	11.0-11.9	3.1	3.1003	2658.79	11.5-12.6	11.5-12.0
AY Cru	11.1-12.2	1.598383	1.59845	3087.764	11.3-12.5	11.3-11.4
DS Eri	10.0-11.0	0.827701	0.82762	2987.584	10.8-11.5	10.8-11.1
RU Gru	11.0-11.4	1.89664	1.8932	2906.63	11.0-11.8	11.0-11.1
RY Gru	11.7-12.3	2.01063	2.0129	2206.566	11.7-12.5	11.7-11.8
AK Gru	11.0-11.5	0.49389	0.49368	2939.689	11.5-12.4	11.5-11.7
TV Ind	11.7-12.2	0.57686	0.57666	2838.872	10.7-11.3	10.7-11.0
RR Men	11.8-12.6	2.6011	2.59959	2196.67	11.4-12.8	not discernable
TV Mic	11.7-12.6	2.0762	2.0784	2812.733	12.4-13.4	12.4-13.3
UZ Mic	11.9-12.4	0.440964	0.44114	2434.775	13.1-13.6	13.1-13.6
VY Mic	9.4-9.7	4.4358	4.4364	2216.56	9.5-10.5	9.5-9.6
TT Mus	11.9-12.7	3.53479	3.5343	2784.61	12.9-14.0	not discernable
SZ Nor	12.3-12.6	1.47456	1.47465	2838.581	13.0-13.7	13.0-13.6
BI Pav	10.7-11.3	2.52694	2.5272	2562.61	10.5-11.3	10.5-10.6
BT Pav	11.0-12.8	2.544	2.54416	2136.631	10.7-12.0	10.7-10.8
HQ Pav	12.5-12.8	0.9262	0.92568	2136.608	12.1-12.7	12.1-12.3
HY Pav	11.4-12.3	0.3516	0.351657	2558.556	11.3-12.1	11.3-11.9
CF Pup	9.4-12.6	7.64556	7.6498	2795.46	10.2-12.2	10.2-10.3
CI Pup	11.3-12.6	1.65792	1.6577	2720.650	11.4-12.8	$<$ 0.1
GY Pup	11.9-12.3	0.412209	0.41218	3048.658	11.2-11.9	11.2-11.9
GZ Pup	11.7-12.2	0.320274	0.320266	3080.668	11.1-11.8	11.1-11.7
HI Pup*	10.7-11.0	0.432651	0.432617	1968.571	10.4-10.8	10.4-10.8
SV Pyx	10.0-11.0	1.4424	1.4464	1952.664	10.7-11.4	$<$ 0.1
TV Pyx	12.1-12.5	0.646765	0.64667	2747.66	11.1-11.7	11.1-11.2
V0756 Sco*	10.5-11.1	10.78	10.771	2703.82	10.3-11.5	10.3-10.5
CG Vel	10.6-12.5	3.685	3.6845	2056.5	11.2-12.6	11.2-11.3
FW Vel	9.5-10.2	2.384082	2.3835	2026.559	10.5-11.3	10.5-11.1
YY Vel	10.6-11.1	4.1636	4.164	1933.74	11.0-11.8	11.0-11.1
ZZ Vel	9.93-10.39	2.87615	5.752	3051.68	9.9-10.3	9.9-10.3
W Vol	10.9-11.8	2.758361	2.75815	2229.8	10.6-11.8	10.6-10.7

*Notes on individual stars:
LW Cen = range appears to have markedly decreased
HI Pup = primary total
V0756 Sco = primary total?

Table 2. Corrected elements for 85 eclipsing binary stars.

	GCVS		Updated		ASAS-3 (V mag)	
Star Name	Range	Period(d)	Period(d)	Epoch	Pri Range	Sec Range
VW Ant	10.2-12.5	5.5462	1.08402	2741.621	11.2-12.5	11.2-11.6
XX Ant	8.7-9.2	8.107	0.88801	3052.812	8.6-9.2	8.6-9.2
XY Ant	9.5-10.2	1.837962	2.1803	2249.783	10.0-10.6	10.0-10.5
Y Ant	10.1-10.7	3.0519244	6.1039	1930.737	10.0-10.7	10.0-10.6
CD Aps	11.3-11.8	0.89366	3.3016	2526.614	11.5-12.1	11.5-11.8
FY Aps	10.9-11.7	5.49935	2.749675	2164.502	10.7-11.8	10.7-10.9
LO Aps	11.3-11.8	0.7988	1.3312	2756.759	11.2-11.8	11.2-11.7
V0843 Aql	9.8-10.2	1.497957	9.024	2433.72	9.8-10.2	9.8-10.0
MM Ara	11.0-12.0	1.27828	2.5566	2102.592	11.3-12.0	11.3-11.9
V0349 Ara	8.6-8.8	1.13837	2.6518	2193.489	8.6-9.1	8.6-8.9
V0610 Ara	8.8-9.2	1.48406	0.543166	2495.508	8.9-9.3	8.9-9.3
V0620 Ara	9.0-9.8	1.554965	3.10993	2405.747	10.0-11.5	> 0.1
AF Cap	10.1-10.8	6.03145	5.935	2034.91	10.8-12.2	10.8-10.9
DQ Car	11.1-11.5	0.86691	1.73368	2804.49	11.1-11.8	11.1-11.6
DV Car	10.0-10.3	0.8405	1.68147	1954.696	10.5-11.1	10.5-10.9
DX Car	10.6-10.8	10.466	21.01	3008.78	11.5-11.9	11.5-11.8
EN Car	10.58-10.9	1.53498	3.07	3072.841	10.3-10.7	10.3-10.6
FP Car	10.1-11.5	176.027	176.35	2706.7	9.7-10.5	> 0.1
GP Car	12.4-12.8	2.264192	2.424	3070.706	11.5-11.9	11.5-11.8
QR Car	10.0-10.5	1.197375	0.749005	2750.728	9.4-10.1	9.4-9.6
PV Cen	11.4-12.5	1.91733	3.8346	2868.5	11.5-12.2	11.5-12.0
V0498 Cen	10.3-11.3	6.30038	0.75751	2038.623	11.0-12.4	11.0-11.2
V0614 Cen	10.7-11.0	3.47361	6.947	3038.87	10.6-11.1	10.6-10.9
V0742 Cen	9.4-10.2	6.49	0.864454	2031.554	9.5-10.2	9.5-10.0
V0775 Cen	9.9-10.6	1.327286	0.663641	1961.767	9.7-10.3	9.7-9.9
V0805 Cen	9.9-10.3	2.211155	3.3167	2459.477	10.0-10.5	10.0-10.2
WZ Cet	10.8-11.4	6.645088	4.6122	1869.578	10.2-10.8	10.2-10.8
AQ Cir	11.0-11.7	0.57284	1.14568	3096.765	11.1-11.8	11.1-11.6
BD Cir	9.4-9.9	0.86956	6.791	1977.75	10.2-11.0	10.2-10.4
BG Cir	9.6-10.3	1.911485	24.8	2548.5	10.6-12.4	10.6-10.7
BN Cir*	9.2-9.6	6.7125	4.4098	2643.85	10.1-10.7	10.1-10.5
AR CMa	11.9-12.5	1.166069	2.33228	3075.678	10.9-11.6	10.9-11.5
FQ CMa	9.6-10.2	2.652	0.724734	3034.646	11.0-12.3	11.0-11.2
SZ CMa	10.2-11.1	2.8560849	5.712	2250.757	10.5-11.2	10.5-11.1
SV Col	11.4-12.2	3.6218	2.752	2134.87	11.8-12.4	11.8-12.3
V0412 CrA	10.7-11.3	4.837	9.666	2955.51	10.1-10.6	10.1-10.3
AA Cru	10.8-11.4	1.89382	3.7877	2831.6	11.2-11.7	11.2-11.5
BQ Eri	10.5-11.0	1.429712	0.82197	3051.601	10.7-11.0	10.7-10.8
CI Eri	9.5-10.5	3.38288	1.2382	2082.911	9.6-10.7	9.6-9.7
AR Gru	10.0-10.6	2.29672	10.681	2892.68	11.5-12.9	11.5-11.7
SZ Hor	10.4-10.8	0.4804562	0.6251	3081.526	11.0-11.8	11.0-11.2
DZ Hya	11.4-11.9	1.08777	2.1755	2649.817	10.9-11.6	10.9-11.4
FW Hya	12.2-12.5	0.509603	0.406135	1948.72	11.2-11.6	11.2-11.5
RU Ind	11.3-12.1	35.54	5.206	2183.55	11.2-12.6	11.2-11.3
FW Lib	9.8-10.2	1.495095	2.24275	2027.674	11.5-14.2	> 0.1
FR Lup	10.1-10.8	1.264033	5.177	1982.74	10.5-11.5	10.5-10.8
FZ Lup	9.4-9.8	2.26731	4.535	2717.746	10.0-10.6	10.0-10.5
BL Mus*	11.1-11.8	5.0126	9.897	2703.74	11.2-11.9	not discernable
UV Mus	10.2-11.4	2.003273	4.0066	2235.835	10.5-11.3	10.5-11.3
HX Nor	12.3-12.9	33.754	67.49	2548.51	11.4-12.2	11.4-12.1
LU Nor	11.9-12.4	0.47618	2.6551	3060.849	12.0-13.1	not discernable
NP Pav	10.7-11.7	1.266821	0.63341	2016.846	11.0-12.0	11.0-11.2
VW Phe	10.57-11.14	1.74216	6.884	2819.94	10.4-11.3	10.4-10.5
WX Phe	11.9-12.9	1.387	2.7776	1868.585	12.3-13.2	12.3-12.6

Table 2 cont'd. Corrected elements for 85 eclipsing binary stars.

	GCVS		Updated		ASAS-3 (V mag)	
Star Name	Range	Period(d)	Period(d)	Epoch	Pri Range	Sec Range
AW Pup	10.2-10.9	0.68108	1.3622	2545.834	9.7-10.2	9.7-10.15
BK Pup	10.4-10.7	1.50127	3.0025	2645.73	10.3-10.7	10.3-10.6
CU Pup	11.4-12.3	3.33738	6.676	3060.59	10.7-11.4	10.7-11.3
MW Pup	8.8-9.2	2.398735	1.7109	3005.709	9.3-9.8	9.3-9.7
SU Pyx	11.4-12.5	5.06953	2.5348	2763.592	11.2-12.7	> 0.1
TX Pyx	9.5-9.9	1.123745	0.562751	1939.652	9.9-10.4	9.9-10.2
TZ Pyx	10.7-11.1	0.6973125	2.31854	2226.773	10.7-11.4	10.7-11.3
FU Sco	12.0-12.8	11.2682	5.6349	2137.52	12.1-12.7	12.1-12.2
V0385 Sco	10.9-11.7	2.34515	4.69	2197.49	10.9-11.5	10.9-11.4
V0565 Sco	10.6-11.0	6.289269	12.579	2813.79	10.4-10.9	10.4-10.6
V0591 Sco	11.7-12.4	0.777684	1.55537	3079.824	11.9-12.7	11.9-12.7
V0606 Sco	11.9-12.2	1.342884	2.6857	2757.78	11.7-12.4	11.7-12.3
V0632 Sco	11.5-11.9	1.610168	3.2204	2834.734	11.1-11.7	11.1-11.6
V0714 Sco	12.2-12.8	0.6982113	1.3965	2564.53	ri 11.8-12.4	11.8-12.3
V0885 Sco	8.6-8.9	3.119975	9.298	2951.51	9.3-9.7	9.3-9.6
V0904 Sco	10.0-10.4	2.533993	1.267	2712.845	10.4-11.1	10.4-10.5
EQ Sct	11.7-12.6	1.3217788	3.8966	2388.83	11.3-11.8	11.3-11.5
V0356 Sct	12.0-12.4	1.061441	2.1229	2924.545	11.7-12.4	11.7-12.3
V0766 Sgr	11.0-12.9	147.105	294.2	2158.51	10.8-11.5	10.8-11.4
V2349 Sgr	8.76-9.4	5.02565	3.4085	2105.64	8.5-9.0	8.5-8.6
V2617 Sgr	9.56-10.1	0.9972646	1.26753	2086.772	9.5-10.2	9.5-9.6
NS Tel*	9.2-9.6	3.9445	1.3397	2764.796	9.6-10.0	9.6-9.8
EM TrA	10.1-10.5	1.03026	2.13159	1964.811	10.0-10.8	10.0-10.7
SS TrA*	10.5-11.3	1.72043	8.601	2040.66	10.8-11.5	10.8-11.3
AQ Vel	11.5-12.0	1.042499	2.085	3079.651	11.9-12.7	11.9-12.6
DU Vel	10.8-11.5	1.552563	3.1051	2949.85	11.6-12.4	11.6-12.4
DZ Vel	10.5-11.0	2.81044	5.621	3124.52	11.4-11.9	11.4-11.9
FH Vel	11.6-12.0	1.457473	3.915	3110.62	12.2-12.6	12.2-12.5
FT Vel	10.1-11.2	1.05975	1.1306	3040.726	11.2-12.5	11.2-11.4
FV Vel	10.2-10.7	3.04228	1.95848	1984.60	10.1-10.5	10.1-10.4
FQ Vir	10.1-10.9	3.018375	0.749602	2069.558	10.0-10.9	10.0-10.1

*Notes on individual stars:
BN Cir = very eccentric: secondary phase = 0.78
BL Mus = period actually 19.79d?
NS Tel = O'Connell effect
SS TrA = very eccentric: secondary phase = 0.2

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163. LIST OF MINIMA TIMINGS OF ECLIPSING BINARIES BY BBSAG OBSERVERS

(BBSAG Bulletin No. 130)

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The following Table 1 lists 559 timings of minima of eclipsing binaries secured both by photoelectrical as well as by visual means by BBSAG observers, primarily obtained between July 2003 and June 2004. The given O-C values generally refer to the linear elements of the GCVS (Kholopov et al., 1985), except for the cases stated in the remarks. All times given are heliocentric UTC.

Table 1: Eclipsing binaries

Variable	Type	HJD 24...	±	$O-C$	n	Obs	Remarks
UU And	p	52855.571	0.003	+0.045	9	KL	vis
XZ And	p	52884.631	0.002	+0.133	7	KL	vis
CP And	p	52898.352	0.009	+0.260	6	KL	vis
EP And	p	52862.504	0.004	0.000	6	KL	vis
HS And	p	52903.516	0.003	+0.257	57	APs	CCD
GK And	p	52871.444	0.010	−0.036	31	APs	CCD; elem. BAV Rb. 108
GZ And	s	52991.354	0.008	+0.001	6	KL	vis
YY Aps	p	53084.3601	0.0020		204	FH	CCD
CX Aqr	p	52854.590	0.002	−0.001	7	KL	vis
CZ Aqr	p	52850.524	0.004	−0.023	6	KL	vis
DY Aqr	p	52854.495	0.010	+0.241	81	APs	CCD
GK Aqr	s	52871.554	0.003	−0.043	7	KL	vis; elem. Per. Zv. 22, 327
GSC568:1658 Aqr	s	52938.386	0.003	−0.012	7	KL	vis; elem. IBVS No. 5455
	p	52962.372	0.004	−0.006	5	KL	vis
XZ Aql	p	52875.452	0.008	+0.132	6	KL	vis
FK Aql	p	53150.495	0.008	−0.061	6	KL	vis
V340 Aql	p	52904.388	0.005	+0.065	6	KL	vis
V479 Aql	p	53150.545	0.004	−0.018	6	KL	vis
V719 Aql	p	52861.47	0.01	−2.38	25	APs	CCD
V803 Aql	p	53149.520	0.003	−0.057	6	KL	vis
V873 Aql	s	53182.498	0.005	+0.041	7	KL	vis
T Aur	p	52283.261	0.002	−0.015	40	APs	CCD
RY Aur	p	52908.585	0.005	+0.025	7	KL	vis
CL Aur	p	52924.488	0.005	+0.108	6	KL	vis
KU Aur	p	52898.595	0.003	+0.025	9	KL	vis

Table 1: Eclipsing binaries (cont.)

Variable	Type	HJD 24...	±	$O-C$	n	Obs	Remarks
TU Boo	p	52863.366	0.006	+0.009	5	KL	vis; elem. AA Suppl. 117, 105
TY Boo	s	52839.3945	0.0003	−0.0117	18	EBl	CCD; elem. BAV Mitt. 68, 21
TZ Boo	p	52839.3973	0.0007	+0.819	22	EBl	CCD
VW Boo	p?	52839.4131	0.0006	−0.0699	20	EBl	CCD; elem. MNRAS 246, 47
XY Boo	p	53117.4774	0.0012	+0.0077	17	EBl	CCD; elem. AJ 76, 923
YY Boo	p	53145.459	0.005	−0.088	219	APs	CCD
AR Boo	s	53094.4343	0.0013	+0.0167	17	EBl	CCD; elem. IBVS No. 4601
GM Boo	p	53081.5055	0.0014	+0.0163	15	EBl	CCD; elem. IBVS No. 5125
GN Boo	s	53081.4332	0.0016	+0.0097	13	EBl	CCD; elem. IBVS No. 5125
GQ Boo	p	52839.5053	0.0012	+0.0006	18	EBl	CCD; elem. IBVS No. 5125
	p	53081.451	0.002	+0.007	12	EBl	CCD
GR Boo	p	53081.3967	0.0012	+0.0031	11	EBl	CCD; elem. IBVS No. 5125
Y Cam	p	52862.519	0.003	+0.246	6	KL	vis
TY Cnc	p	53081.384	0.005	−0.207	6	KL	vis
AB Cnc	p	52965.602	0.006	+0.017	5	KL	vis; elem. IBVS No. 5337
VV CVn	p	53094.5297	0.0013	−0.0146	26	EBl	CCD; elem. IBVS No. 5403
YZ CVn	p	53117.5662	0.0005	−0.0060	19	EBl	CCD
BI CVn	s	52321.607	0.003	+0.014	12	JVb	vis; elem. IBVS No. 4554
	s	52338.496	0.003	−0.002	13	JVb	vis
	p	52370.604	0.002	+0.025	14	JVb	vis
	p	53094.4474	0.0015	+0.0240	15	EBl	CCD
DF CVn	p	53068.3543	0.0018	+0.0226	17	EBl	CCD; elem. IBVS No. 5021
DH CVn	s	53068.4033	0.0009	−0.0051	17	EBl	CCD, elem. IBVS No. 5149
GSC2004:784 CVn	p	53045.468	0.003	−0.001	12	EBl	CCD; elem. IBVS No. 5269
GSC2533:1519 CVn	p	53045.4713	0.0011	+0.0034	16	EBl	CCD; elem. IBVS in preparation
	s	53060.4671	0.0020	+0.0041	29	EBl	CCD
	p	53060.706	0.003	−0.003	7	EBl	CCD
	p	53068.5685	0.0008	−0.0029	16	EBl	CCD
	p	53081.347	0.003	−0.001	7	EBl	CCD
	s	53094.3764	0.0019	+0.0053	18	EBl	CCD
	p	53094.6153	0.0012	−0.0015	17	EBl	CCD
	s	53117.4705	0.0014	+0.0026	24	EBl	CCD
GSC2534:216 CVn	s	53068.3536	0.0011	−0.0013	12	EBl	CCD; elem. IBVS No. 5403
	p	53068.478	0.002	0.000	11	EBl	CCD
GSC2534:1121 CVn	p	53045.4896	0.0015	−0.0013	15	EBl	CCD; elem IBVS in preparation
	s	53060.3985	0.0018	+0.0007	18	EBl	CCD
	p	53060.5698	0.0012	+0.0007	32	EBl	CCD
	p	53068.4488	0.0017	−0.0021	14	EBl	CCD
	p	53081.4698	0.0020	−0.0032	13	EBl	CCD
	s	53094.3252	0.0023	+0.0014	10	EBl	CCD
	p	53094.4965	0.0010	+0.0014	28	EBl	CCD
	p	53117.4565	0.0008	+0.0014	24	EBl	CCD
	s	53117.6272	0.0025	+0.0007	9	EBl	CCD
GSC2536:122 CVn	p	52856.397	0.007	−0.002	7	KL	vis; elem IBVS No. 5403
	p	53045.4972	0.0013	−0.0012	11	EBl	CCD
	p	53055.607	0.007	+0.008	8	KL	vis
	s	53060.508	0.007	0.000	6	KL	vis
	s	53079.575	0.005	−0.012	5	KL	vis
	p	53085.619	0.007	0.000	5	KL	vis
	s	53111.573	0.004	+0.002	5	KL	vis
	p	53112.554	0.002	+0.001	7	KL	vis
	s	53117.467	0.003	+0.004	5	KL	vis
	p	53117.604	0.002	+0.001	5	KL	vis
	p	53137.525	0.003	+0.002	6	KL	vis

Table 1: Eclipsing binaries (cont.)

Variable	Type	HJD 24...	±	$O-C$	n	Obs	Remarks
GSC2537:520 CVn	s	53045.5866	0.0018	+0.0041	12	EBl	CCD; elem. IBVS in preparation
	s	53060.4205	0.0010	−0.0035	23	EBl	CCD
	p	53060.6083	0.0012	−0.0013	22	EBl	CCD
	p	53068.402	0.006	+0.001	6	EBl	CCD
	s	53068.5850	0.0006	−0.0019	14	EBl	CCD
	p	53081.3868	0.0019	−0.0009	12	EBl	CCD
	p	53094.3736	0.0013	−0.0005	19	EBl	CCD
	s	53094.5600	0.0017	+0.0004	18	EBl	CCD
	p	53117.3783	0.0014	−0.0002	14	EBl	CCD
	s	53117.5665	0.0016	+0.0025	23	EBl	CCD
GSC2544:1007 CVn	p	53045.4760	0.0009	−0.0018	16	EBl	CCD: elem. IBVS in preparation
	s	53060.4579	0.0013	+0.0001	22	EBl	CCD
	p	53060.6181	0.0020	+0.0027	18	EBl	CCD
	p	53068.4984	0.0018	−0.0012	16	EBl	CCD
	p	53081.4294	0.0019	−0.0003	16	EBl	CCD
	p	53094.3569	0.0012	−0.0028	14	EBl	CCD
	s	53094.5212	0.0021	+0.0038	17	EBl	CCD
	p	53117.3811	0.0017	−0.0004	14	EBl	CCD
	s	53117.5393	0.0011	+0.0001	20	EBl	CCD
GSC2548:936 CVn	p	52991.654	0.006	−0.001	6	KL	vis; elem. IBVS No. 5403
	p	53035.726	0.004	+0.001	5	KL	vis
	s	53036.635	0.004	−0.002	6	KL	vis
	s	53045.5010	0.0017	−0.0027	13	EBl	CCD
	p	53055.548	0.005	+0.004	5	KL	vis
	s	53055.675	0.002	+0.001	6	KL	vis
	p	53060.500	0.002	+0.002	7	KL	vis
	p	53063.630	0.003	+0.004	6	KL	vis
	p	53079.532	0.002	−0.002	5	KL	vis
	p	53110.565	0.003	0.000	6	KL	vis
	p	53111.610	0.003	+0.002	6	KL	vis
	s	53112.522	0.004	+0.001	5	KL	vis
	p	53117.482	0.003	+0.006	6	KL	vis
	p	53117.605	0.003	−0.001	8	KL	vis
	p	53120.472	0.003	−0.002	5	KL	vis
	s	53121.388	0.004	+0.001	5	KL	vis
	p	53137.425	0.003	0.000	6	KL	vis
	p	53150.465	0.003	+0.002	6	KL	vis
GSC3022:996 CVn	p	53045.4478	0.0004	−0.0020	13	EBl	CCD; elem. IBVS No. 5403
GSC3026:1046 CVn	s	53045.360	0.004	+0.006	6	EBl	CCD; elem. IBVS No. 5269
	p	53045.5332	0.0007	+0.0054	15	EBl	CCD
RX CMa	p	52940.582	0.003	−0.119	7	KL	vis
RY CMi	p	52991.641	0.008	−0.212	6	KL	vis; elem. IBVS No. 4874
UZ CMi	s	49004.554	0.005	−0.028	16	JVb	vis; elem. 51925.4166 + 0.551361 * E (T. Pribulla)
	p	50836.488	0.005	+0.009	13	JVb	vis
	p	50862.405	0.007	+0.012	17	JVb	vis
	p	51190.471	0.008	+0.019	11	JVb	vis
	p	51248.358	0.004	+0.013	7	JVb	vis
	p	52693.468	0.005	+0.006	51	Aps	CCD
	s	53081.350	0.005	−0.005	126	APs	CCD
AK CMi	p	52912.620	0.004	+0.017	6	KL	vis
AO CMi	p	52282.372	0.002	−0.094	123	APs	CCD
ZZ Cas	s	52981.394	0.002	+0.007	29	EBl	CCD
AB Cas	p	52863.582	0.002	+0.082	7	KL	vis
AE Cas	p	52964.560	0.005	+0.076	5	KL	vis

Table 1: Eclipsing binaries (cont.)

Variable	Type	HJD 24...	±	$O-C$	n	Obs	Remarks
AH Cas	p	52964.572	0.006	−0.189	6	KL	vis
BH Cas	s	52964.264	0.004	+0.011	10	EBl	CCD; elem. IBVS No. 4482
BW Cas	p	52878.590	0.005	+0.008	10	KL	vis; elem. BBSAG Bull. 122, 8
CV Cas	p	52945.358	0.008	+0.537	7	KL	vis
CW Cas	p	52964.2691	0.0007	−0.0272	11	EBl	CCD; elem. JAAVSO 21, 34
	s	52981.3277	0.0014	−0.0278	21	EBl	CCD
DP Cas	s	52964.229	0.006	+0.076	10	EBl	CCD
DZ Cas	p	52991.301	0.002	−0.159	18	EBl	CCD
EY Cas	s	52964.280	0.002	−0.014	11	EBl	CCD
FV Cas	p	53052.369	0.008	+0.871	17	RD	CCD
IR Cas	p	52840.495	0.002	+0.012	6	KL	vis
KL Cas	p	52884.587	0.005	−0.010	6	KL	vis
LQ Cas	p	52981.380	0.002	−0.189	21	EBl	CCD
MM Cas	p	52981.3387	0.0004	+0.0734	20	EBl	CCD
MY Cas	p	52964.228	0.002	+0.026	12	EBl	CCD
NT Cas	p	52981.310	0.002	+0.033	21	EBl	CCD
V350 Cas	p	52908.593	0.004	−0.026	6	KL	vis
V387 Cas	p	52981.3892	0.0013	+0.0489	17	EBl	CCD
V448 Cas	p	52981.318	0.004	+0.081	15	EBl	CCD
V520 Cas	p	52991.3271	0.0010	+0.0551	16	EBl	CCD; elem. BBSAG Bull. 117, 9
V523 Cas	s	52844.482	0.003	+0.011	6	KL	vis; elem. MNRAS 317, 111
	p	52981.3138	0.0004	+0.0166	20	EBl	CCD
	s	52981.4311	0.0010	+0.0171	5	EBl	CCD
V651 Cas	p	52991.3173	0.0007	+0.0022	16	EBl	CCD; elem. IBVS No. 3554
GSC3667:826 Cas	p	53060.649	0.003	−0.009	8	KL	vis; elem. IBVS No. 5500
	p	53063.587	0.002	−0.012	8	KL	vis
	p	53112.611	0.001	−0.013	7	KL	vis
	p	53117.523	0.003	−0.004	10	KL	vis
	p	53120.452	0.005	−0.016	10	KL	vis
	p	53121.438	0.005	−0.011	6	KL	vis
	p	53165.550	0.002	−0.022	10	KL	vis
	p	53166.534	0.002	−0.018	11	KL	vis
WZ Cep	s	52991.3184	0.0011	−0.0401	18	EBl	CCD; elem. A&AS 131, 17
BE Cep	p	52986.3533	0.0010	−0.0864	21	EBl	CCD
BR Cep	p	52904.478	0.008	−0.007	8	KL	vis
CM Cep	p	52853.525	0.005	−0.025	6	KL	vis
DE Cep	p	52856.446	0.007	−0.018	6	KL	vis
	p	52986.353	0.003	−0.012	19	EBl	CCD
DK Cep	p	52986.3350	0.0005	+0.0354	22	EBl	CCD
	p	53182.529	0.002	+0.034	7	KL	vis
DP Cep	p	52877.437	0.007	−0.068	5	KL	vis
IO Cep	p	52862.589	0.003	0.000	7	KL	vis
IP Cep	p	52986.3640	0.0012	−0.0143	22	EBl	CCD; elem. IBVS No. 5016
LL Cep	p	52986.2651	0.0014	+0.0028	10	EBl	CCD
NU Cep	p	52986.3488	0.0009	+0.0156	27	EBl	CCD
V357 Cep	p	52908.321	0.006	−0.183	8	KL	vis; elem. Brno Contr. 28, 34
V358 Cep	p	52871.542	0.003	+0.031	6	KL	vis; elem. BBSAG Bull. 96, 10
SS Cet	p	52940.554	0.006	+0.012	6	KL	vis
TW Cet	s	52874.615	0.002	−0.027	6	KL	vis
VY Cet	s	52876.608	0.003	+0.005	7	KL	vis
AA Cet	p	52924.468	0.003	−0.020	6	KL	vis
GSC4686:2315 Cet	p	52908.515	0.004	+0.010	8	KL	vis; elem. IBVS No. 5257

Table 1: Eclipsing binaries (cont.)

Variable	Type	HJD 24...	±	$O-C$	n	Obs	Remarks
LL Com	p	53117.4049	0.0007	+0.1249	19	EBl	CCD; elem. IBVS No. 4386
LO Com	p	53068.4078	0.0013	+0.0053	15	EBl	CCD; elem. IBVS No. 5052
LP Com	s	53068.3127	0.0013	−0.0071	12	EBl	CCD; elem. IBVS No. 5052
	p	53068.4871	0.0008	−0.0017	12	EBl	CCD
GSC1996:437 Com	p	53068.331	0.007	−0.009	7	EBl	CCD; elem. IBVS No. 5269
	s	53068.5366	0.0011	−0.0095	23	EBl	CCD
TU CrB	p	53175.419	0.008	−.540	5	KL	vis
GSC2040:1361 CrB	s	52835.3715	0.0008	−0.0016	16	EBl	CCD; elem. IBVS No. 5295
GSC2579:1125 CrB	p	52835.4036	0.0006	+0.0006	21	EBl	CCD; elem. IBVS No. 5295
W Crv	p	53052.498	0.002	+0.032	6	KL	vis
Z Crv	p	52734.42	0.01	−0.04	12	APs	CCD
V Crt	p	53040.596	0.005	−0.005	7	KL	vis
UW Cyg	p	52879.493	0.008	+0.029	6	KL	vis
WW Cyg	p	52829.518	0.002	+0.045	9	KL	vis
WZ Cyg	p	52844.486	0.003	+0.054	5	KL	vis
ZZ Cyg	p	52840.414	0.004	−0.047	6	KL	vis
BR Cyg	p	52855.600	0.003	0.000	8	KL	vis
DX Cyg	p	53149.449	0.004	−0.050	6	KL	vis
V525 Cyg	p	52908.334	0.004	−0.023	6	KL	vis
V706 Cyg	p	53179.484	0.003	−0.037	8	KL	vis
V726 Cyg	p	52850.531	0.006	+0.048	5	KL	vis
V728 Cyg	p	53164.492	0.008	+0.062	8	KL	vis
V1036 Cyg	p	52907.371	0.004	−0.002	10	JVb	vis; elem. IBVS No. 5204
V1048 Cyg	p	53163.429	0.002	+0.012	10	KL	vis
V1130 Cyg	p	53173.550	0.002	−0.030	11	KL	vis
V2239 Cyg	p	52146.545	0.004	−0.042	7	JVb	vis; elem. IBVS No. 4819
	p	52886.461	0.002	−0.064	9	JVb	vis
V2280 Cyg	s	52820.4681	0.0006	+0.0203	29	EBl	CCD; elem. IBVS No. 4996
	s	53082.638	0.007	−0.001		KL	vis
V2282 Cyg	p	52820.4998	0.0007	−0.0169	22	EBl	CCD; elem. IBVS No. 4996
V2284 Cyg	s	52820.5073	0.0002	−0.0006	20	EBl	CCD; elem. IBVS No. 4985
V2290 Cyg	p	52840.458	0.005	−0.019	6	KL	vis; elem. IBVS No. 5018
V2294 Cyg	s	52820.4443	0.0004	+0.0532	19	EBl	CCD; elem. IBVS No. 4995; period corrected: 0.3543005
W Del	p	52873.486	0.002	+0.022	10	KL	vis
TT Del	p	52941.287	0.008	−0.087	9	KL	vis
XX Del	p	52875.495	0.010	−0.332	19	APs	CCD
EX Del	p	52875.402	0.005	+0.004	34	APs	CCD; elem. BBSAG Bull. 114, 11
FZ Del	p	52855.588	0.002	−0.039	9	KL	vis
Z Dra	p	52867.393	0.006	−0.147	5	KL	vis
RR Dra	p	52858.499	0.002	+0.059	8	KL	vis
SX Dra	p	53121.521	0.008	+0.083	8	KL	vis
WX Dra	p	53137.480	0.006	+0.010	11	KL	vis
AI Dra	p	52823.449	0.006	+0.047	9	CPa	vis
AR Dra	p	52879.422	0.003	+0.006	7	KL	vis
AU Dra	p	53107.556	0.003	−0.005	7	KL	vis; elem. IBVS No. 4587
BU Dra	p	53144.546	0.009	+0.039	12	KL	vis
DW Dra	p	52908.412	0.002	+0.020	6	KL	vis; elem. BBSAG Bull. 118, 7
IV Dra	p	52831.4403	0.0006	−0.0063	14	EBl	CCD; elem. INVS No. 4610; period corrected: 0.268105
KK Dra	p	52850.452	0.003	+0.012	7	KL	vis; elem. JAAVSO 28, 91
GSC3533:1400 Dra	s	52859.577	0.005		13	EBl	CCD; elem. to be determined
GSC3549:929 Dra	p	52424.495	0.002	+0.004	9	JVb	vis; elem. IBVS No. 5232

Table 1: Eclipsing binaries (cont.)

Variable	Type	HJD 24...	±	$O-C$	n	Obs	Remarks
GSC3888:464 Dra	p	52752.5207	0.0008	−0.0021	16	EBl	CCD; elem. IBVS No. 5505
	p	52753.4695	0.0015	−0.0040	25	EBl	CCD
	s	52753.6316	0.0016	−0.0004	12	EBl	CCD
	s	52802.4356	0.0015	+0.0004	14	EBl	CCD
	s	52807.5013	0.0013	−0.0044	30	EBl	CCD
	p	52831.4315	0.0012	−0.0004	22	EBl	CCD
	s	52854.4050	0.0005	−0.0024	23	EBl	CCD
	p	52854.5657	0.0015	−0.0002	24	EBl	CCD
	s	52859.4743	0.0007	−0.0036	11	EBl	CCD
ZZ Eri	p	52693.320	0.005	−0.007	16	APs	CCD
	s	52938.552	0.007	−0.018	41	APs	CCD
RW Gem	p	53052.543	0.003	+0.003	7	KL	vis
TX Gem	p	53028.563	0.003	−0.015	6	KL	vis
AF Gem	p	52978.628	0.003	−0.057	6	KL	vis
BD Gem	p	52997.598	0.005	−0.022	6	KL	vis
SZ Her	p	52832.525	0.002	−0.024	10	KL	vis
TU Her	p	52875.422	0.005	−0.138	8	KL	vis
CC Her	p	53096.625	0.001	+0.142	11	KL	vis
DP Her	p	52853.430	0.004	+0.069	7	KL	vis
DQ Her	p	53149.502	0.001	+0.004	7	KL	vis
GL Her	p	53140.544	0.003	+0.061	6	KL	vis
MT Her	p	52829.484	0.007	+0.012	6	KL	vis
V366 Her	p	52840.394	0.003	−0.086	6	KL	vis
V842 Her	p	51722.475	0.005	+0.033	14	JVb	vis; elem. IBVS No. 3946
	p	52215.280	0.005	+0.058	9	JVb	vis
	s	52321.498	0.004	+0.052	13	JVb	vis
V1034 Her	p	53149.585	0.004	+0.005	5	KL	vis; elem. IBVS No. 5231
V1044 Her	s	52875.387	0.004	+0.009	6	KL	vis; elem. IBVS No. 5192
	s	53096.5234	0.0015	−0.0035	9	EBl	CCD
V1047 Her	p	53096.5125	0.0021	−0.0026	11	EBl	CCD; elem. IBVS No. 5192
V1053 Her	p	52850.432	0.003	+0.008	6	KL	vis; elem. BBSAG Bull. 128, 10
	p	53096.4892	0.0019	+0.0001	10	EBl	CCD
V1055 Her	s	53096.423	0.004	−0.007	8	EBl	CCD; elem. IBVS No. 5192
V1062 Her	p	53096.4300	0.0016	−0.0060	10	EBl	CCD; elem. IBVS No. 4965
	s	53096.555	0.006	−0.007	6	EBl	CCD
V1065 Her	p	52442.481	0.003	−0.006	8	JVb	vis; elem. IBVS No. 5228
V1067 Her	s	53096.460	0.003	+0.005	9	EBl	CCD; elem. IBVS No. 4966
V1073 Her	s	53096.5255	0.0009	+0.0029	10	EBl	CCD; elem. IBVS No. 4975
GSC1537:1557 Her	s	52753.4336	0.0010	+0.0002	18	EBl	CCD; elem. IBVS No. 5505
	p	52753.5923	0.0006	−0.0003	22	EBl	CCD
	s	52802.4474	0.0006	−0.0004	25	EBl	CCD
	p	52812.4734	0.0006	−0.0001	32	EBl	CCD
	s	52815.4974	0.0008	+0.0003	30	EBl	CCD
	p	52856.3962	0.0006	+0.0008	18	EBl	CCD
	s	52856.5543	0.0006	−0.0002	18	EBl	CCD
	p	52898.4072	0.0008	−0.0005	17	EBl	CCD
GSC1549:121 Her	p	52752.5028	0.0010	−0.0008	16	EBl	CCD; elem. IBVS No. 5505
	s	52753.4969	0.0006	−0.0009	37	EBl	CCD
	s	52802.4135	0.0014	−0.0007	17	EBl	CCD
	p	52812.5538	0.0003	−0.0017	27	EBl	CCD
	s	52815.5392	0.0007	+0.0010	27	EBl	CCD
	s	52835.426	0.002	+0.003	10	EBl	CCD
	s	52856.5016	0.0006	+0.0009	25	EBl	CCD
	p	52871.4141	0.0007	−0.0002	20	EBl	CCD
	p	52875.3910	0.0007	−0.0002	17	EBl	CCD

Table 1: Eclipsing binaries (cont.)

Variable	Type	HJD 24...	±	$O-C$	n	Obs	Remarks
GSC2056:117 Her	p	52850.426	0.003		6	KL	vis
	p	52867.360	0.006		6	KL	vis
	p	53035.725	0.005		5	KL	vis
	p	53079.604	0.004		8	KL	vis
	s	53082.630	0.003		6	KL	vis
	p	53095.629	0.002		6	KL	vis
	s	53112.569	0.003		6	KL	vis
	s	53117.554	0.004		5	KL	vis
	s	53137.524	0.002		6	KL	vis
	p	53150.532	0.002		6	KL	vis
GSC2083:1870 Her	s	53096.5127	0.0011	−0.0002	11	EBl	CCD; elem. IBVS No. 5306
GSC2613:1412 Her	s	53096.507	0.003	+0.007	11	EBl	CCD; elem. IBVS No. 5306
GSC2614:1369 Her	s	52871.3707	0.0005	+0.0005	14	EBl	CCD; elem. IBVS No. 5516
	p	52871.5390	0.0004	+0.0015	16	EBl	CCD
	s	52875.3868	0.0007	+0.0001	19	EBl	CCD
	s	52886.4318	0.0007	−0.0004	17	EBl	CCD
	p	52898.3170	0.0016	+0.0026	15	EBl	CCD
	s	52898.4811	0.0008	−0.0007	20	EBl	CCD
	p	52899.318	0.004	−0.001	10	EBl	CCD
	p	52907.3516	0.0010	0.0000	16	EBl	CCD
	p	52924.424	0.004	+0.002	9	EBl	CCD
	s	52926.2598	0.0011	−0.0030	10	EBl	CCD
	s	52928.2711	0.0011	+0.0001	7	EBl	CCD
	s	53143.4896	0.0023	−0.0006	11	EBl	CCD
GSC2615:1821 Her	p	52871.350	0.002	0.000	13	EBl	CCD; elem. IBVS No. 5516
	s	52871.5209	0.0003	+0.0008	20	EBl	CCD
	p	52875.4319	0.0006	+0.0007	21	EBl	CCD
	p	52886.3144	0.0008	+0.0003	12	EBl	CCD
	s	52886.4839	0.0011	−0.0002	15	EBl	CCD
	s	52898.3874	0.0005	0.0000	20	EBl	CCD
	s	52899.4069	0.0012	−0.0007	16	EBl	CCD
	p	52907.4008	0.0015	+0.0010	14	EBl	CCD
	p	52924.4035	0.0012	−0.0009	12	EBl	CCD
	s	52926.2737	0.0013	−0.0012	14	EBl	CCD
	s	52928.316	0.002	0.000	12	EBl	CCD
	p	53143.4254	0.0006	+0.0018	11	EBl	CCD
GSC2618:1385 Her	p	52871.3752	0.0007	−0.0007	15	EBl	CCD; elem. IBVS No. 5516
	s	52871.5447	0.0011	+0.0002	16	EBl	CCD
	p	52875.4215	0.0007	−0.0002	20	EBl	CCD
	s	52886.3799	0.0005	+0.0010	14	EBl	CCD
	p	52898.3467	0.0011	−0.0009	15	EBl	CCD
	s	52898.5173	0.0009	+0.0011	13	EBl	CCD
	p	52899.3591	0.0004	0.0000	18	EBl	CCD
	s	52907.283	0.002	+0.001	6	EBl	CCD
	p	52924.3074	0.0016	−0.0004	9	EBl	CCD
	p	52926.3303	0.0019	−0.0004	13	EBl	CCD
	p	52928.3537	0.0003	+0.0001	13	EBl	CCD
	s	53107.543	0.002	−0.003	8	KL	vis
	s	53110.577	0.002	−0.003	7	KL	vis
	s	53111.584	0.003	−0.009	8	KL	vis
	s	53112.604	0.002	0.000	7	KL	vis
	p	53117.496	0.003	+0.004	5	KL	vis
	p	53120.531	0.001	+0.004	6	KL	vis
	s	53137.551	0.004	−0.002	5	KL	vis
	p	53143.4509	0.0015	−0.0018	12	EBl	CCD
GSC2629:1932 Her	p	53143.4556	0.0006	−0.0004	11	EBl	CCD; elem. IBVS No. 5333

Table 1: Eclipsing binaries (cont.)

Variable	Type	HJD 24...	±	$O-C$	n	Obs	Remarks
GSC3098:683 Her	p	53096.381	0.002	−0.001	11	EBl	CCD; elem. IBVS No. 5306
GSC3098:1253 Her	p	53096.421	0.003	+0.001	8	EBl	CCD; elem. IBVS No. 5306
	s	53096.5463	0.0006	+0.0054	8	EBl	CCD
GSC3510:1283 Her	p	52871.3771	0.0009	+0.0015	15	EBl	CCD; elem. IBVS No. 5516
	s	52871.5177	0.0018	−0.0001	15	EBl	CCD
	s	52875.4151	0.0012	+0.0004	24	EBl	CCD
	p	52886.4074	0.0013	−0.0021	16	EBl	CCD
	p	52898.3778	0.0013	−0.0008	17	EBl	CCD
	s	52898.5178	0.0013	0.0000	13	EBl	CCD
	s	52899.3533	0.0013	+0.0005	11	EBl	CCD
	p	52907.2856	0.0018	−0.0002	8	EBl	CCD
	s	52907.426	0.002	+0.001	8	EBl	CCD
	s	52924.4056	0.0008	+0.0012	10	EBl	CCD
	s	52926.353	0.004	0.000	9	EBl	CCD
	s	52928.3021	0.0011	+0.0008	11	EBl	CCD
	s	53143.4620	0.0022	−0.0042	11	EBl	CCD
GSC3528:44 Her	s	53143.5091	0.0015	+0.0003	10	EBl	CCD; elem. IBVS No. 5333
GSC3532:174 Her	p	52840.446	0.005	+0.003	6	KL	vis; elem. IBVS No. 5333
	p	52850.457	0.004	−0.012	6	KL	vis
	p	53080.626	0.004	+0.001	5	KL	vis
	p	53085.636	0.007	−0.002	7	KL	vis
	p	53117.545	0.004	+0.005	5	KL	vis
	p	53120.514	0.003	+0.011	6	KL	vis
	s	53121.504	0.004	−0.016	5	KL	vis
	s	53143.4042	0.0004	−0.0001	8	EBl	CCD
	p	53143.516	0.004	−0.002	6	EBl	CCD
GSC3532:939 Her	s	52856.357	0.008	+0.001	6	KL	vis; elem. IBVS No. 5333
	p	52856.515	0.009	+0.004	6	KL	vis
	s	53143.4280	0.0023	+0.0058	10	EBl	CCD
VW Hya	p	52997.584	0.007	+0.209	8	KL	vis
AS Hya	p	52965.637	0.005	−0.043	5	KL	vis; elem. BBSAG Bull. 83, 5
DE Hya	p	52938.650	0.008	+0.046	8	KL	vis
DG Lac	p	52834.427	0.009	−0.213	5	KL	vis
OO Lac	p	52856.594	0.005	+0.134	7	KL	vis
Y Leo	p	52998.640	0.004	+0.022	6	KL	vis
BL Leo	p	52978.646	0.004	−0.031	4	KL	vis
GSC263:256 Leo	p	52964.712	0.004	+0.002	6	KL	vis; elem. IBVS No. 5455
	p	52997.739	0.004	0.000	6	KL	vis
	p	53048.525	0.007	−0.003	5	KL	vis
	p	53052.583	0.002	+0.004	7	KL	vis
	p	53063.490	0.002	+0.005	8	KL	vis
	p	53079.373	0.002	−0.002	8	KL	vis
	p	53080.629	0.004	+0.008	5	KL	vis
	p	53092.462	0.003	0.000	7	KL	vis
	p	53093.393	0.001	−0.004	10	KL	vis
	p	53110.534	0.002	0.000	6	KL	vis
	p	53116.454	0.002	0.000	10	KL	vis
	p	53150.415	0.003	−0.003	5	KL	vis
Z Lep	p	52962.620	0.003	+0.039	6	KL	vis; elem. JAAVSO 21, 111
RS Lep	p	53010.514	0.002	+0.002	6	KL	vis
TY Lib	p	53093.590	0.004	−0.009	7	KL	vis
BW Lib	p	53060.630	0.004	−0.008	7	KL	vis; elem. IBVS No. 5335
Δ Lib	p	52819.364	0.010	−0.008	19	APs	CCD
RY Lyn	p	53028.465	0.005	−0.038	7	KL	vis
BG Lyn	p	52284.462	0.006	−0.024	14	JVb	vis; elem. GEOS Circ. EB 16
	p	52308.436	0.002	−0.046	13	JVb	vis
RV Lyr	p	52886.382	0.007	−0.106	6	KL	vis

Table 1: Eclipsing binaries (cont.)

Variable	Type	HJD 24...	±	$O-C$	n	Obs	Remarks
UZ Lyr	p	53142.500	0.005	−0.023	10	KL	vis
AH Lyr	p	53121.450	0.005	−0.090	6	KL	vis
EW Lyr	p	52850.564	0.005	+0.235	6	KL	vis
V400 Lyr	p	53151.3721	0.0022	−0.0178	13	EBl	CCD; elem. IBVS No. 4995
V404 Lyr	p	53111.560	0.003	−0.076	8	KL	vis
V574 Lyr	s	53151.4644	0.0015	−0.0035	12	EBl	CCD; elem. IBVS No. 4976
V579 Lyr	s	53151.4236	0.0007	−0.0037	12	EBl	CCD; elem. IBVS No. 4982
V580 Lyr	p	53151.4639	0.0018	−0.0083	13	EBl	CCD; elem. IBVS No. 4982
V582 Lyr	s	52879.373	0.005	+0.004	6	KL	vis; elem. IBVS No. 4985
	s	53151.4163	0.0008	+0.0254	16	EBl	CCD
GSC3104:1384 Lyr	p	53151.4322	0.0010	+0.0014	10	EBl	CCD; elem. IBVS No. 5232
GSC3108:57 Lyr	p	52886.3874	0.0016	+0.0008	14	EBl	CCD; elem. IBVS No. 5525
	s	52899.4771	0.0010	−0.0002	6	EBl	CCD
	p	52907.4058	0.0017	+0.0003	12	EBl	CCD
	p	52924.3685	0.0011	+0.0004	14	EBl	CCD
	s	52946.3086	0.0012	−0.0003	24	EBl	CCD
	p	52948.3374	0.0007	+0.0004	23	EBl	CCD
	p	52951.2865	0.0003	−0.0006	10	EBl	CCD
	p	53150.4144	0.0005	+0.0009	14	EBl	CCD
GSC3109:859 Lyr	p	52886.3474	0.0012	+0.0006	12	EBl	CCD; elem. IBVS No. 5525
	p	52899.473	0.002	−0.001	7	EBl	CCD
	p	52924.3215	0.0013	+0.0006	17	EBl	CCD
	s	52928.3054	0.0006	−0.0004	16	EBl	CCD
	p	52946.3548	0.0008	−0.0004	20	EBl	CCD
	p	52948.2309	0.0007	+0.0004	15	EBl	CCD
	s	52951.2780	0.0005	+0.0002	22	EBl	CCD
	s	53150.5253	0.0007	+0.0007	19	EBl	CCD
GSC3526:1995 Lyr	s	52886.3627	0.0015	+0.0016	10	EBl	CCD; elem. IBVS No. 5525
	p	52886.510	0.004	+0.003	7	EBl	CCD
	p	52899.365	0.002	−0.002	15	EBl	CCD
	s	52907.4029	0.0010	−0.0007	11	EBl	CCD
	s	52924.358	0.002	+0.003	10	EBl	CCD
	p	52926.257	0.002	+0.003	6	EBl	CCD
	p	52928.300	0.003	0.000	12	EBl	CCD
	s	52946.2714	0.0011	−0.0026	14	EBl	CCD
	s	52948.3175	0.0019	−0.0022	16	EBl	CCD
	s	52951.2405	0.0007	−0.0018	11	EBl	CCD
	p	53150.4161	0.0013	0.0000	14	EBl	CCD
	s	53150.462	0.003	0.000	11	EBl	CCD
GSC3526:2369 Lyr	p	52886.3638	0.0008	+0.0003	12	EBl	CCD; elem. IBVS No. 5525
	s	52899.411	0.002	+0.002	15	EBl	CCD
	s	52907.3374	0.0005	+0.0025	14	EBl	CCD
	p	52924.3430	0.0011	−0.0002	13	EBl	CCD
	p	52926.3258	0.0011	+0.0010	13	EBl	CCD
	p	52928.3073	0.0012	+0.0009	13	EBl	CCD
	s	52946.3040	0.0013	−0.0015	23	EBl	CCD
	s	52948.2845	0.0008	−0.0025	27	EBl	CCD
	p	52948.4519	0.0015	−0.0003	8	EBl	CCD
	s	52951.2573	0.0012	−0.0021	21	EBl	CCD
	s	53150.4065	0.0003	+0.0010	14	EBl	CCD
	p	53150.5766	0.0014	+0.0059	10	EBl	CCD
GSC3540:85 Lyr	p	53151.4794	0.0022	+0.0031	13	EBl	CCD; elem. IBVS No. 5232

Table 1: Eclipsing binaries (cont.)

Variable	Type	HJD 24...	±	$O-C$	n	Obs	Remarks
RW Mon	p	52962.448	0.005	−0.048	6	KL	vis
TV Mon	p	52990.425	0.006	+0.031	6	KL	vis
UU Mon	p	52940.537	0.004	+0.006	6	KL	vis
BM Mon	p	52940.653	0.006	+0.035	6	KL	vis
BO Mon	p	52924.669	0.005	−0.056	8	KL	vis
BZ Mon	p	52964.581	0.008	−0.139	5	KL	vis
U Oph	p	52848.406	0.004	+0.001	9	CPa	vis
RV Oph	p	53151.452	0.004	−0.007	6	KL	vis
UU Oph	p	52816.331	0.001	−0.039	353	RDr	CCD
V391 Oph	p	53171.523	0.004	+0.039	7	KL	vis
V415 Oph		52825.510	0.008		82	APs	CCD; no elem. in the GCVS
V449 Oph	p	53120.564	0.003	+0.065	10	KL	vis
V508 Oph	s	52829.502	0.004	−0.003	6	KL	vis
V509 Oph	p	52817.5455	0.0010	+0.0392	190	RDr, APs	CCD
V566 Oph	s	52854.390	0.005	+0.083	47	APs	CCD
V913 Oph	p	53095.618	0.004	+0.173	7	KL	vis
V916 Oph	p	52839.533	0.009	+0.232	8	KL	vis
V1010 Oph	p	52810.420	0.015	−0.101	8	CPa	vis
V1016 Oph	s	52817.313	0.002	−0.073	270	APs	CCD
	s	52828.307	0.003	−0.072	99	APs	CCD
GSC995:1646 Oph	s	52753.4554	0.0018	−0.0008	25	EBl	CCD; elem. IBVS No. 5505
	p	52815.4806	0.0019	−0.0014	31	EBl	CCD
	p	52835.4917	0.0019	+0.0013	19	EBl	CCD
	p	52856.3888	0.0012	+0.0008	17	EBl	CCD
UW Ori	p	53052.305	0.004	+0.034	13	RD	CCD; elem. Chin. AA 14, 298
EQ Ori	p	52997.282	0.004	−0.027	6	KL	vis
FK Ori	p	52878.585	0.008	+0.006	8	KL	vis
OS Ori	p	53030.288	0.006	−0.026	6	KL	vis
V640 Ori	p	52903.622	0.002	−0.110	10	KL	vis
Z Per	p	52896.405	0.008	−0.174	5	KL	vis
TY Peg	p	52885.369	0.003	−0.232	5	KL	vis
BX Peg	s	52887.515	0.005	+0.075	44	APs	CCD
CW Peg	p	52926.313	0.003	+0.057	6	KL	vis
EY Peg	p	52886.461	0.009	+0.021	6	KL	vis; elem. BBSAG Bull. 105, 8
	p	52938.371	0.005	+0.002	31	APs	CCD
RT Per	p	52854.560	0.003	+0.04	7	KL	vis
RV Per	p	52938.623	0.004	−0.004	6	KL	vis
ST Per	p	52860.539	0.005	+0.183	7	KL	vis
WY Per	p	52879.524	0.009	−0.079	7	KL	vis
XZ Per	p	52902.454	0.002	−0.055	8	KL	vis
DK Per	p	52900.472	0.002	−0.029	10	KL	vis; elem. IBVS No. 3875
HW Per	p	53048.470	0.002	+0.003	6	KL	vis; elem. IBVS No. 4516
KW Per	p	52900.561	0.002	+0.011	7	KL	vis
PS Per	p	52885.446	0.002	+0.056	6	KL	vis
Y Psc	p	52899.410	0.008	+0.004	7	KL	vis
SX Psc	p	52854.539	0.008	+0.006	7	KL	vis
XZ Pup	p	52946.600	0.002	+0.101	6	KL	vis
UZ Sge	p	52856.529	0.002	+0.047	6	KL	vis
GSC1621:2192 Sge	p	52829.536	0.003	−0.011	6	KL	vis; elem. BBSAG Bull. 128,10
	p	52839.512	0.004	−0.001	7	KL	vis
	p	52877.532	0.005	−0.002	6	KL	vis
	p	52886.393	0.004	0.000	6	KL	vis
	p	52903.364	0.004	−0.009	6	KL	vis
	s	52945.261	0.003	−0.008	6	KL	vis
	p	52967.232	0.003	−0.001	6	KL	vis
	s	53003.224	0.004	+0.001	6	KL	vis
	p	53094.578	0.003	−0.005	6	KL	vis
	p	53121.532	0.004	+0.002	6	KL	vis

Table 1: Eclipsing binaries (cont.)

Variable	Type	HJD 24...	±	$O-C$	n	Obs	Remarks
XY Sgr	p	53094.614	0.004	-0.001	10	KL	vis
AK Ser	p	53080.646	0.003	$+0.025$	6	KL	vis
AO Ser	p	53052.623	0.003	-0.001	6	KL	vis
AU Ser	p	53040.659	0.004	-0.087	6	KL	vis
BI Ser	p	52733.574	0.004	-0.580	11	JVb	vis
CX Ser	s	53050.611	0.007	-0.079	160	APs	CCS
LX Ser	p	53149.402	0.001	$+0.004$	7	KL	vis
RW Tau	p	52913.449	0.007	-0.185	7	KL	vis
SV Tau	p	53050.455	0.010	-0.010	328	APs	CCD
AH Tau	p	52876.595	0.005	-0.105	6	KL	vis
AM Tau	p	52897.637	0.004	-0.063	7	KL	vis
BN Tau	p	53030.372	0.007	-0.016	5	KL	vis
V Tri	p	52858.534	0.005	-0.003	7	KL	vis
RV Tri	p	52873.567	0.005	-0.018	8	KL	vis
RW Tri	p	52908.336	0.002	-0.004	5	KL	vis
TY Tri	p	51138.406	0.011	-0.164	13	JVb	vis; elem. MVS 11, 1
	p	51432.550	0.007	-0.172	8	JVb	vis
UX UMa	p	52997.586	0.001	$+0.004$	5	KL	vis
VV UMa	p	53099.453	0.003	-0.049	10	KL	vis
XZ UMa	p	53030.464	0.003	-0.066	8	KL	vis
ZZ UMa	p	52901.626	0.003	-0.003	10	KL	vis
AC UMa	p	52913.564	0.007	-0.131	5	KL	vis
HH UMa	p	52754.4057	0.0008	$+0.0003$	-	MMa	CCDV; elem. IBVS No. 5414
LO UMa	p	53049.547	0.009	$+0.099$	6	KL	vis; elem. IBVS No. 5084
UW Vir	p	53060.635	0.004	-0.041	8	KL	vis
VV Vir	p	53063.551	0.003	-0.028	7	KL	vis
AX Vir	p	53099.552	0.003	$+0.008$	10	KL	vis
HW Vir	p	52997.630	0.001	$+0.001$	5	KL	vis; elem. AA 364, 199
GSC2850:1075 Vir	p	52722.577	0.004	-0.052	41	APs	CCD; elem. ASAS
	s	53081.498	0.002	-0.063	43	APs	CCD
RS Vul	p	52823.411	0.002	-0.002	11	CPa	vis
AX Vul	p	52853.501	0.003	-0.026	7	KL	vis
AY Vul	p	52875.486	0.004	-0.066	6	KL	vis
BE Vul	p	52833.534	0.004	$+0.048$	10	KL	vis
BO Vul	p	52885.404	0.007	-0.007	6	KL	vis
BT Vul	p	52530.454	0.008	$+0.003$	11	JVb	vis

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Kholopov, P. N., Samus, N. N., Frolov, M. S., Goranskij, V. P., Gorynya, N. A., Kireeva, N. N., Kukarkina, N. P., Kurochkin, N. E., Medvedeva, G. I., Perova, N. B., Shugarov, S. Yu., 1985, *General Catalogue of Variable Stars*, Moscow

ERRATUM FOR IBVS 5438, 5543, 5713

As Dr. Samus reported, the star erroneously labelled GSC 02850-01075 is really GSC 00285-01075.

The Editors

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THE CATACLYSMIC VARIABLE V358 LYRAE: REMOVING AMBIGUITIES

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The variable star V358 Lyr = S 9649 was discovered by Hoffmeister (1967). The discoverer gave the photographic range from $16^{\rm m}$ to fainter than $18^{\rm m}$ and considered the star a possible long-period variable. Galkina and Shugarov (1985) found no trace of the star on Moscow plates covering the time interval JD 2434112–2445264. Richter (1986) suggested a cataclysmic-star classification for V358 Lyr. He presented the observations of the variable given in Table 1 (in our presentation of this table, we restore the fractions of the Julian Days dropped by Richter, for clarity of the further discussion). Te_4 are sky patrol plates, GC are plates taken with the 40 cm astrograph ($F = 160$ cm).

Table 1. Observations of V358 Lyr from Richter (1986)

Plate	1965	JD	$m_{\rm pg}$
Te_4 4601	Jun 25	2438937.483	[14.5
Te_4 4609	Jun 29	8941.483	13.27
GC 1387	Aug 4	8977.480	16.42
GC 1388	Aug 19	8992.399	17.31
GC 1389	Aug 23	8996.412	[18.5

Richter (1986) did not find any trace of the star to $21^{\rm m}$ on Palomar prints, concluded that “the question whether V358 Lyr is a classical nova or a WZ Sagittae type object remains open”, but argued for the latter possibility. There is nothing red near the position of V358 Lyr, and thus its being a member of the cataclysmic-variable class is quite plausible.

We found all the plates studied by Richter in the plate stacks of Sonneberg Observatory. Moreover, the plate collection contains several additional plates relevant to the problem, taken with the other Sonneberg 40 cm astrograph, GB ($F = 200$ cm). We generally confirm the results of Table 1. Figure 1 reproduces the field of the star from Hoffmeister’s discovery plate, GC 1387, with the variable marked by Hoffmeister. Its coordinates, measured by us with respect of reference stars from the 2MASS catalog, are:

$$18^{\rm h}59^{\rm m}32\overset{\rm s}{.}95 \quad +42^\circ24'12\overset{''}{.}2 \quad \text{J2000.0}, \quad \text{ep. } 1965.591.$$

These coordinates are accurate to $\sim 0\farcs5$. However, the object's position in Te_4 4609, measured with respect of Tyc2 and GSC stars and accurate to $\sim 2''$,

$$18^{\mathrm{h}}59^{\mathrm{m}}33\fs5 \quad +42^{\circ}24'21'' \quad \mathrm{J2000.0},$$

differs by $14''$, outside estimated errors. Moreover, the region of V358 Lyr in Te_4 4609, shown in Fig. 2, contains at least two more star-like objects missing on DSS images. The plate GB 1911 (JD 2438941.506), with a much better plate limit than for Te_4 4609, whose exposure time partially overlaps the exposure of Te_4 4609, shows nothing in the position of V358 Lyr. In our opinion, the image in Te_4 4609 is a plate defect rather than the variable.

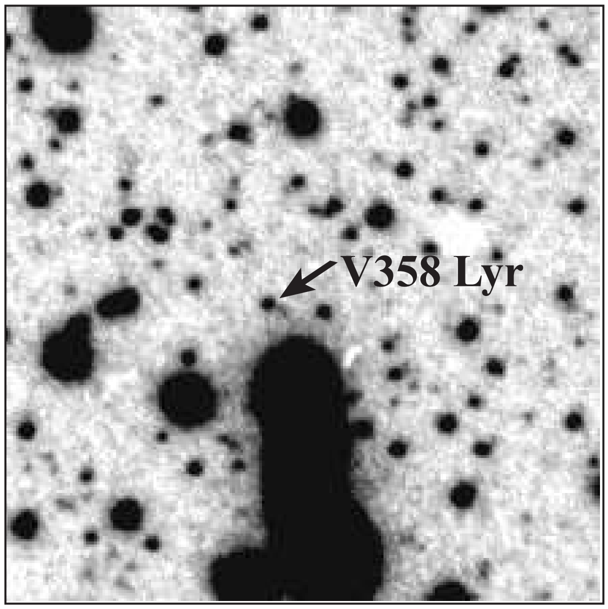

Figure 1. The $10' \times 10'$ field around V358 Lyr on the discovery plate, GC 1387. North is on top, east is to the left. The thick bar below V358 Lyr is the ink mark left by C. Hoffmeister.

We are left with the observations presented in Table 2, replacing the table from Richter (1986).

Table 1. The corrected list of Sonneberg observations for V358 Lyr

Plate	1965	JD	m_{pg}
Te_4 4601	Jun 25	2438937.483	[14.5
GB 1905	Jun 25	8937.503	[17
GB 1908	Jun 28	8940.505	[17
GB 1911	Jun 29	8941.506	[17
GC 1387	Aug 4	8977.480	16.42
GC 1388	Aug 19	8992.399	17.31
GC 1389	Aug 23	8996.412	[18.5

The Moscow plate collection now contains 89 additional plates, not studied by Galkina and Shugarov (1985), covering JD 2445525–2450366. Nothing brighter than 17^{m} can be seen in the position of V358 Lyr.

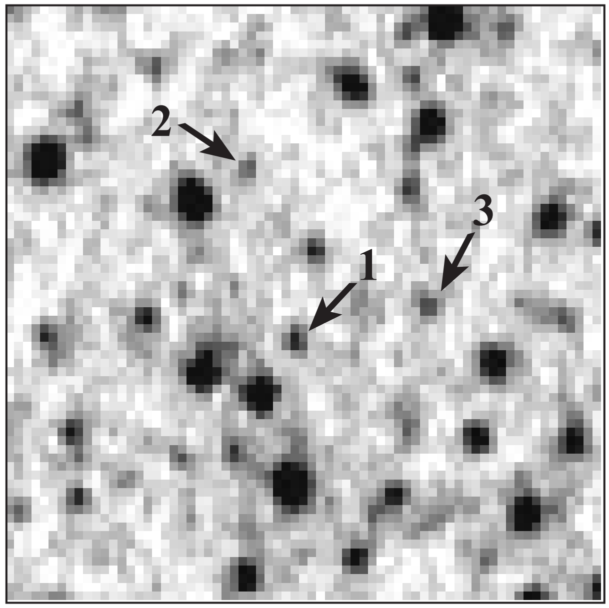

Figure 2. The $20' \times 20'$ field around V358 Lyr on the patrol plate Te_4 4609. The three probable plate defects are marked with numbers 1, 2, 3. No. 1 was identified with V358 Lyr by G. Richter.

We conclude that V358 Lyr is most probably a faint cataclysmic variable with extremely rare outbursts. Richter (1986) argued that the magnitude $13^{\rm m}_{\cdot}3$ in maximum made the star, were it a Nova, unbelievably far from the galactic plane. It is even more so with the corrected magnitude in maximum, $16^{\rm m}_{\cdot}4$. It should be remembered, however, that we know nothing about the star's behavior in July, 1965.

One of us (S.V. Antipin) wishes to thank Sonneberg Observatory for excellent hospitality during his work in the Observatory's plate archive in 2003. Thanks are due to the staff of Sonneberg Observatory for assistance in scanning plates. Sonneberg Observatory is operated by 4π Systeme company. The work of the GCVS team (S.V. Antipin, N.N. Samus) is supported, in part, by grants from the Russian Foundation for Basic Research (grant 02-02-16069), The Federal Scientific and Technological Program "Astronomy", the program "Non-Stationary Processes in Astronomy" of the Presidium of Russian Academy of Sciences, and the program of support for leading scientific schools of Russia (grant NSh-389-2003-2).

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CX CMa - AN EARLY-TYPE DETACHED ECLIPSING BINARY

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The discovery of the variability of CX CMa (= CD $-25°4424$ = GSC 6541-1691, $7^{\mathrm{h}}22^{\mathrm{m}}00\overset{\mathrm{s}}{.}99$, $-25°52'35\overset{''}{.}9$, J2000.0) is credited to Hoffmeister (1931) who labelled it as "58.1931 CMa" although there was some early confusion regarding who discovered its variability (*viz.* Milone, 1986). Milone (1986) obtained photoelectric light curves in U, B, and V in late 1977. He noted that all three curves exhibited asymmetric maxima – for V, the maximum following the secondary minimum (max II) was some 0.05 magnitudes brighter than the other (max I). Unfortunately, both his comparison and check stars have turned out to be variable (NN CMa and MZ CMa, respectively). He also obtained spectra at CTIO enabling him to classify the system as B5 V.

All available times of minima were collected (see Table 1), enabling the present authors to refine the period.

Table 1. Times of Minimum

Source	Type	ToM (HJD-2400000.0)	Error (days)	n	O−C (days)
GCVS 4	I	28095.601	na	−25436	−0.0252
Milone 1986	I	43201.5740	0.0003	−9612	−0.0008
This work	II	52330.154	0.002	−49.5	0.0025
This work	II	52376.9277	0.0004	−0.5	7.3×10^{-6}
This work	I	52388.861	0.001	12	2.6×10^{-5}
Dvorak (2004)	II	52654.7236	0.0003	290.5	0.00075

The best-fit elements (omitting the first value from the fit) used for phasing were:

$$\text{HJD Min I} = 2452377.405 + 0.95462254 \times E$$

A total of 295 B and 316 V magnitudes were taken at the Mt John University Observatory at Lake Tekapo, New Zealand when RHN was a guest at the University of Canterbury in Christchurch, New Zealand in the first half of 2002. The telescope used was the Optical Craftsman 61 cm Cassegrain, equipped with a Santa Barbara Instrument Group ST-9e CCD Camera (on loan from the AAVSO) and using a telecompressor

Table 2. Positions, magnitudes and colour indices

Star	GSC ID	RA	Dec	V	$B-V$
Var	6541-1691	07:22:00.9898	−25:52:35.925	9.98	−0.119
Comp	6541-2881	07:22:12.9485	−25:53:41.608	10.19	−0.038
Check	6541-1436	07:21:50.2243	−25:54:22.143	11.09	+0.465

lens and BVR_CI_C filters. Thin, variable clouds proved to be a problem in the oceanic climate at this site, located as it is in the lee of the Southern Alps. Therefore, plots of the raw comparison magnitudes versus time were used as an unbiased criterion for eliminating questionable points. (An arbitrary limit of changes greater than 0.2 magnitudes in the sampling interval of 2 minutes meant that spatial variations across the chip gave unacceptable systematic errors.) The reduced numbers of points were 253 B and 259 V magnitudes.

Images were reduced in the usual way with dark and bias subtraction and flatfield correction using MIRA, by Axiom Research. Positions (J2000), magnitudes and colours (from the Tycho catalogue, ESA 1997) of observed stars are listed in Table 2.

Analysis of the light curves was done using the 2003 version of the Wilson-Devinney program (WD; Wilson & Devinney, 1971; Wilson, 1979) which employs Kurucz (1993) atmospheres as described by Van Hamme & Wilson (2003). Preliminary inspection of the light curves showed that the system was detached and, thus, mode 2 (Leung & Wilson, 1977) of the WD program was used. The large relative radii and short period argue against a non-circular orbit and no evidence of an orbital eccentricity was seen in the light curves, so we explored only solutions with $e = 0$. Based on the B5 V spectral type, we set $T_1 = 15,200K$ (Cox, 2000).

For a detached binary, the mass ratio (q) has very little influence on the light curve and hence cannot be reliably determined from photometry (*viz.* Terrell and Wilson, 2004). Thus, while q is of great interest in other contexts, our inability to determine it accurately does not adversely affect our ability to determine the other parameters of the system. Since an approximate value of q will suffice for the light curve solution, we estimated it as follows. A B5 V star should have a mass of $5.9M_\odot$ (Cox, 2000). Having assumed an effective temperature of the primary, the eclipse depths give an approximate effective temperature of the secondary of $T_2 = 10,600K$. If the secondary is also a main sequence star (likely, given the detached configuration of the binary), then its mass should be around $3.4M_\odot$, leading to $q = 0.57$. We allowed q to adjust and found that it changed very little. We also explored solutions with other initial values of q and found that it had little effect on the values of the other parameters.

Our solutions employed the detailed treatment of the reflection effect (Wilson, 1990) with five reflections which has previously proven to be sufficient (Terrell, 2002). We also explored solutions with the various limb darkening laws, namely the linear cosine, logarithmic and square root laws (Van Hamme, 1993), and found that the logarithmic law gave a marginally better solution than the square root law, while both of the two-parameter laws were significantly better than the linear cosine law. Our final solution, listed in Table 3, uses the logarithmic law with coefficients from Van Hamme (1993). Since both stars have radiative envelopes, we set their bolometric albedos and gravity darkening exponents to unity from theoretical considerations (von Zeipel, 1924a, 1924b, 1924c). Figure 1 shows the fits to the two light curves.

Table 3. Parameters from the Light Curve Solution

Parameter	Value	Std. Error
ϕ_0	0.0019	0.0001
i	89°.4	1°.3
T_2	10,502 K	25 K
q	0.56	0.01
Ω_1	3.64	0.02
Ω_2	3.87	0.06
$L_1/(L_1+L_2)_B$	0.837	0.001
$L_1/(L_1+L_2)_V$	0.822	0.001
$r_{1(pole)}$	0.322	0.002
$r_{1(point)}$	0.348	0.003
$r_{1(side)}$	0.331	0.002
$r_{1(back)}$	0.341	0.003
$r_{2(pole)}$	0.211	0.005
$r_{2(point)}$	0.222	0.006
$r_{2(side)}$	0.214	0.005
$r_{2(back)}$	0.220	0.006

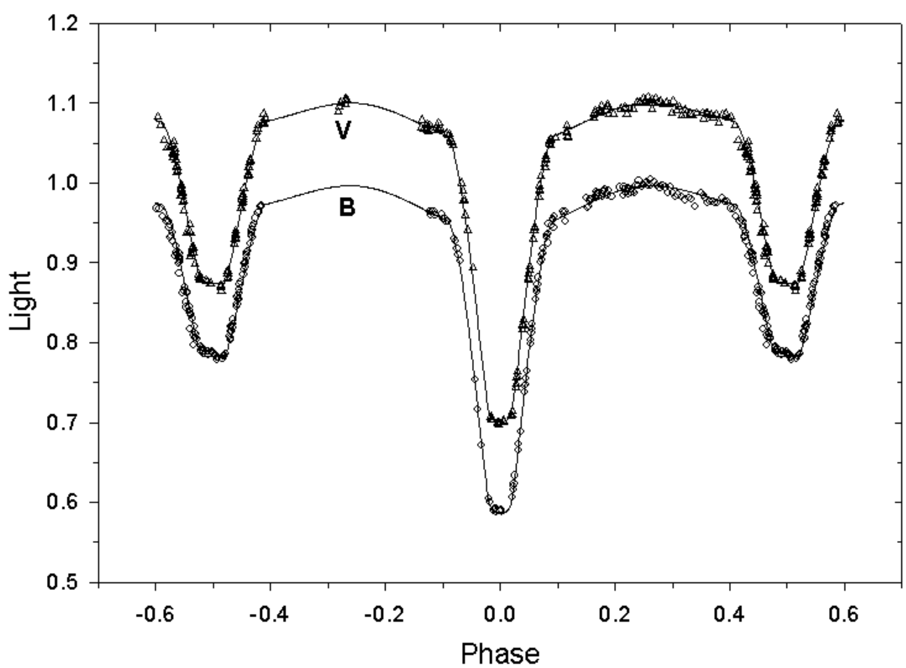

Figure 1. Fits to the B and V light curves of CX CMa.

CX CMa thus appears to be a relatively unevolved binary consisting of a B5V primary and a secondary with a spectral type in the B8 to A0 range. Although we have only a few observations in one of the maxima, we see no asymmetry between the maxima in our 2002 data as opposed to the noticeable asymmetries in the 1977 data reported by Milone (1986). It is unclear whether the asymmetries in the 1977 data were real and have since changed, as observed in other binaries like XZ CMi (Terrell and Henden, 2002), or whether they are an artefact of the use of comparison and check stars that have subsequently turned out to be variable. We hope to obtain high resolution spectra of the system as part of our program on early-type close binaries (*viz.* Terrell, *et al.*, 2003 on TU Muscae) so that absolute parameters and interstellar reddening can be determined.

The photometric data are available from the IBVS web site as `5545-t4.txt` and `5545-t5.txt`.

It is a pleasure for RHN to thank the staff members at MJUO (especially Alan Gilmore) for their splendid help and assistance. Thanks are also due to the faculty and staff at the University of Canterbury for their very warm welcome and hospitality. RHN would also like to thank E.F. Milone for suggesting this star as an observing target. This research has made use of the SIMBAD database, operated at CDS, Strasbourg, France

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GSC 3449-0688 - A NEW SOLAR-TYPE OVERCONTACT BINARY

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GSC 3449-0688 ($10^h45^m15^s+52^\circ16'49''$, 2000.0) was discovered to be variable by RHN on 2004 February 18 during filtered CCD observations of nearby BH UMa. Further CCD observations by RHN and TK over the next few nights and into March quickly established a period. Table 1 contains all the available times of minimum and deviations from the best fit linear relation.

Table 1. Observed minima of GSC 3449-0688

HJD - 2400000	Error	Type	Cycle	$O-C$ (days)	Observer
53053.804	0.01	I	−3	−0.002	Nelson
53053.974	0.01	II	−2.5	−0.004	Nelson
53054.8371	0.0001	I	0	0.0000	Nelson
53055.3529	0.0003	II	1.5	0.0000	Krajci
53055.5253	0.0002	I	2	0.0005	Krajci
53057.7602	0.0002	II	8.5	0.0003	Nelson
53057.9317	0.0002	I	9	−0.0001	Nelson
53058.9635	0.0002	I	12	0.0001	Nelson
53059.6509	0.0010	I	14	−0.0002	Nelson
53066.8716	0.0006	I	35	−0.0006	Nelson
53067.0450	0.0006	II	35.5	0.0009	Nelson
53074.7807	0.0003	I	58	−0.0002	Nelson
53074.9528	0.0003	II	58.5	−0.0001	Nelson
53077.7032	0.0003	II	66.5	−0.0005	Nelson
53077.8758	0.0002	I	67	0.0001	Nelson

The following elements were determined (where the numbers in brackets are the errors in the units of the last digit):

$$\text{JD Hel Min I} = 53054.8371(1) + 0.343854(4)\text{E}$$

A total of 135 and 162 observations in V and Rc respectively was made by RHN at the Sylvester Robotic Observatory (see Nelson 2002b). They were reduced using MIRA by

Table 2. Positions and magnitudes

Star	GSC 3449-	RA HH.MMSSss	Dec DD.MMSSs	V mag	Error mag	$B-V$ mag	Error mag	$V-R$ mag	Error mag
Variable	0688	10.451472	52.16485	13.686	0.242	0.640	0.002	0.400	0.005
Comp	0707	10.453084	52.10144	11.590	0.018	0.681	0.005	0.366	0.008
Check	0726	10.451102	52.12136	13.103	0.006	0.547	0.016	0.319	0.006

Axiom Research (for Windows; this platform was used by Nelson throughout his part of the study), in the usual way (ibid).

Henden (2004) used the USNO Flagstaff Station 1.0-m. telescope equipped with a SITe/Tektronix 1024×1024 CCD to observe the field in the standard Johnson-Cousins BVRcIc passbands on several photometric nights, using Landoldt standards to calibrate the field. Astrometry is based on USNO-A 2.0 and has errors less than 100mas internal error. Comparison and check stars were standardized as follows in Table 2:

Assuming no interstellar reddening (a reasonable assumption at the galactic latitude of 55 degrees) and main sequence stars, a colour index of $B-V = 0.64$ implies a spectral type of G3 and a $\log g$ value of 4.444 (cgs units, Allen, 1973), and a primary temperature T1 = 5751 K (Flower, 1996).

The photometric data were analyzed by the Wilson Devinney (WD) light curve analysis program (Wilson and Devinney, 1971, Wilson, 1990) using an interface program, 'WD-Wint' written by the author (see Nelson, et al., 2002b). The general appearance of the curve suggested an overcontact binary; hence mode 3 was chosen. The following settings were selected: convective envelopes (appropriate for solar-type stars), giving albedos of A1 = A2 = 0.5 and gravity exponents of g1 = g2 = 0.32 and the logarithmic (LD=2) limb darkening law, appropriate for cooler stars (Bessell, 1979). Limb darkening values were found from a program by Terrell (1994) that interpolates from van Hamme's tables (van Hamme, 1993). Black body radiation was used initially, but later runs employed the atmosphere option of WD taken from the Carbon and Gingerich atmospheres (Carbon & Gingerich, 1969).

After a best-fit solution was found, third light was tested for and the predicted correction less than the estimated error. Therefore third light may be ruled out. The final values are given in Table 3, the final light curves are plotted in Figure 1, and a 3-D representation at phase 0.25 generated by Binary Maker 3-D (Bradstreet, 1993) is shown in Figure 2.

Acknowledgements:

Thanks are due to Environment Canada for the website satellite images (see 'Satellite images' below) that were essential in predicting clear times for observing runs in this cloudy locale and to Attila Danko for his Clear Sky Clocks, (see below).

Table 3. Solution parameters

Quantity	Value Star 1	Value Star 2	Error	Quantity	Value	Error
F	1.000	1.000	[fixed]	q = M2/M1	0.331	0.003
g	0.320	0.320	[fixed]	i (deg)	81.2	0.4
A	0.500	0.500	[fixed]	L1/(L1+L2) (V)	0.704	0.003
x (bol)	0.138	0.138	[fixed]	L1/(L1+L2) (Rc)	0.708	0.003
y (bol)	0.636	0.636	[fixed]	φ_0	0.005	0.0003
x (V)	0.550	0.550	[fixed]	e	0	0.002
y (V)	0.254	0.254	[fixed]	r1 (pole)	0.453	0.002
x (Rc)	0.653	0.653	[fixed]	r1 (side)	0.487	0.003
y (Rc)	0.138	0.138	[fixed]	r1 (back)	0.514	0.002
T1 (K)	5751		[fixed]	r2 (pole)	0.273	0.003
T2 (K)		5921	14	r2 (side)	0.285	0.004
Ω	2.510	2.510	0.009	r2 (back)	0.232	0.006
f (fill factor)	0.12	0.12	0.03	$\Sigma\ \omega^2_{\rm res}$	0.0266	na

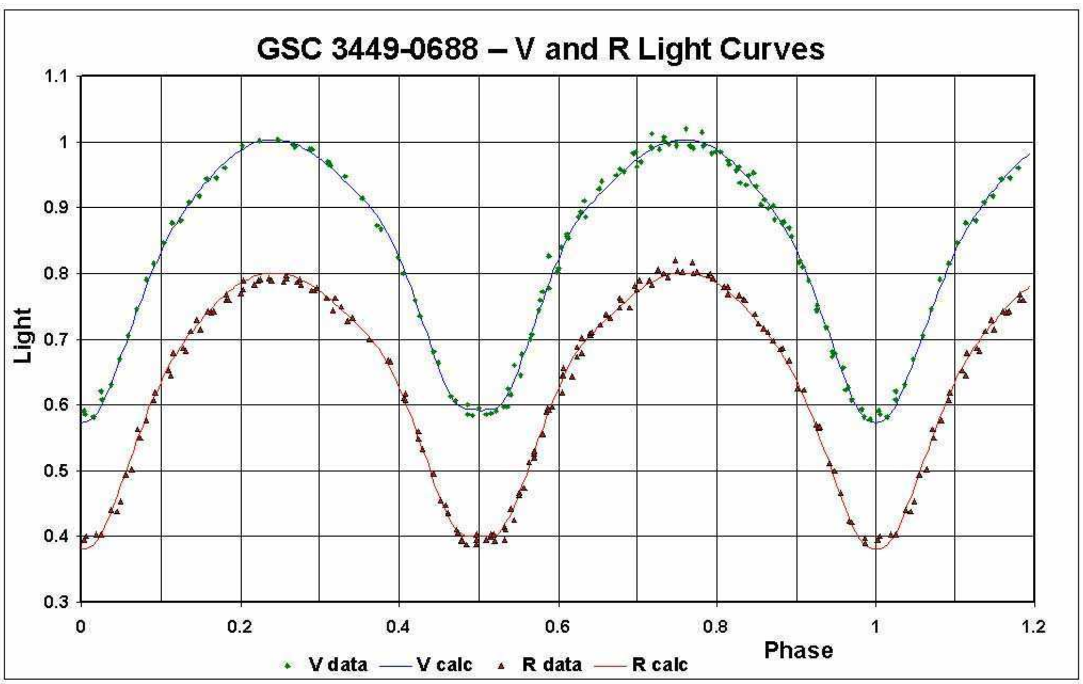

Figure 1.

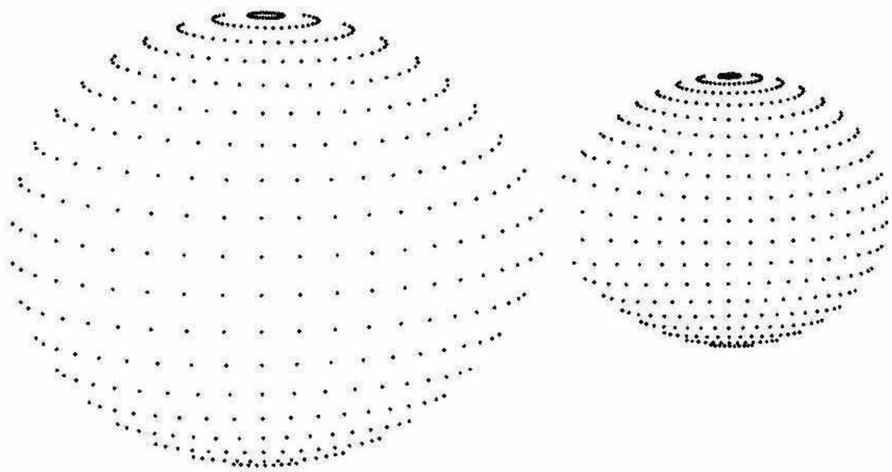

Figure 2.

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PRELIMINARY SOLUTIONS FOR THE ECLIPSING BINARIES ROTSE1 J180616.31+280109.1, V883 Her, V507 Lyr, MQ Peg, AND MX Peg

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Observed star(s):				
Star name	GCVS type	Coordinates (J2000) RA	Dec	Comp./check star(s)
ROTSE1 J180616.31+280109.1	EW	$18^h06^m16\overset{s}{.}3$	$+28°01'09''$	CTI catalog
V883 Her	EW	$17^h50^m46\overset{s}{.}5$	$+28°00'49''$	CTI catalog
V507 Lyr	EW	$18^h40^m48\overset{s}{.}5$	$+28°01'38''$	CTI catalog
MQ Peg	EW	$22^h48^m10\overset{s}{.}4$	$+28°05'19''$	CTI catalog
MX Peg	EW	$23^h22^m15\overset{s}{.}0$	$+28°05'33''$	CTI catalog

Observatory and telescope:
CCD Transit Instrument (CTI), 1.8-m f/2.2 meridian pointing telescope
Capilla Peak Observatory (CAP), 0.61-m f/15.2 Cassegrain telescope
US Air Force Academy Observatory (AFA), 0.61-m f/15.6 Cassegrain telescope

Detector:	CTI: RCA LN2-cooled CCD, 320 × 512 pixels, $8\overset{'}{.}3$ wide strip, CAP: RCA LN2-cooled CCD, 320 × 512 pixels, $3\overset{'}{.}6 \times 5\overset{'}{.}2$ FOV, AFA: Photometrics LN2-cooled CCD, 512 × 512 pixels, $3\overset{'}{.}6 \times 3\overset{'}{.}6$ FOV.

Filter(s):	CTI: BVR, CAP: V, AFA: BVR

Date(s) of the observation(s):
CTI: 1987.10–1991.05, CAP: 1994.06–1996.10, AFA: 2003.06–2003.09

ROTSE1 J180616.31+280109.1 (hereafter J180616) previously discovered in the ROTSE test field (Akerlof et al. 2000) and recently identified during a new search for variable stars in the CCD/Transit Instrument (CTI) databases, along with four other W UMa stars identified by Wetterer et al. 1996 (hereafter W96) in the CTI survey (V883 Her,

V507 Lyr, MQ Peg, and MX Peg) were chosen for observations as part of a Consortium for Astronomy Research and Teaching (CART) summer project at the US Air Force Academy (AFA) Observatory and follow-up independent cadet study of modeling W UMa eclipsing systems. The CTI data and 1994 CAP data for V883 Her, V507 Lyr, MQ Peg, and MX Peg were previously used in the photometric analysis in W96.

Table 1: Photometric Characteristics

	J180616	V883 Her	V507 Lyr	MQ Peg	MX Peg
V_{Max}	12.737(2)	13.146(3)	14.266(3)	13.434(4)	16.326(13)
V_{MinP}	13.151(1)	13.355(6)	14.720(6)	13.694(5)	16.611(6)
V_{MinS}	13.039(1)	13.323(5)	14.689(7)	13.685(8)	16.587(8)
V_{Mean}	12.875(1)	13.224(1)	14.422(1)	13.539(1)	16.056(10)
$(B-V)$	0.414(12)	0.412(10)	0.57(6)	0.502(5)	0.63(5)
$(V-R)$	0.255(3)	0.257(6)	0.379(21)	0.314(3)	0.44(6)
$E(B-V)$	0.100	0.061	0.181	0.061	0.063
period	0.6600655(20)	0.695016(3)	0.3669098(10)	0.3793826(15)	0.3943902(20)
epoch	52906.674(4)	52843.788(7)	52865.694(5)	52901.8527(23)	52872.955(8)

Photometric characteristics for these stars are listed in Table 1: V_{Max}, V_{MinP}, and V_{MinS} are the average standard V magnitudes at maximum, primary minimum, and secondary minimum light (CAP and AFA magnitudes transformed to CTI instrumental magnitudes via differential photometry with nearby stars in CTI database and then to standard magnitudes as detailed in W96); V_{Mean} is the flux averaged standard V magnitude; $(B-V)$ and $(V-R)$ are the standard colors (recalculated from all available CTI and AFA data); $E(B-V)$ is reddening (as estimated from HI maps in Burstein and Heiles 1982); period is in days (using V photometry and employing Lafler and Kinman's period finding algorithm (Lafler and Kinman 1965)); and epoch is HJD - 2400000 of latest primary minima measured. Observations of all stars were planned to fill in the light curve and not necessarily measure a minimum timing. For those nights where a minimum was adequately observed, however, the Kwee and Van Woerden method (Kwee and Van Woerden 1956) was used to measure the minimum's timing. This is not possible for the CTI data because CTI observed each star only once per night, however, approximate minima timings can be listed for CTI data (and poorly covered CAP data) by listing the most prominent darkenings (within 10 percent of the known minimum magnitude and given a standard 0.02 day uncertainty). All these minima timings are listed in Table 3.

We used the Binary Star Maker 2.0 software and reference manual (Bradstreet 1993) to obtain preliminary solutions for these eclipsing binaries. By examining the most precise photometry (CAP 1996) V507 Lyr appears to undergo a total eclipse with a broadened secondary eclipse and a rounded and slightly deeper primary eclipse. For this system, we used the measured $B-V$ color to determine surface temperature, and assumed identical temperatures for the primary and secondary. The uncertainty in temperature was determined from the uncertainty in $B-V$ color. We simultaneously adjusted the mass ratio, fillout factor, and inclination to reproduce the observed light curve and list the best fit values and ranges qualitatively estimated by examining model fits. The other four systems appear to have rounded and smoothly varying light curves characteristic of W UMa eclipsing binaries undergoing partial eclipses. For these systems, we used the measured $B-V$ color and eclipse depths to estimate surface temperatures and calculated mass ratios consistent with equivalent temperature stars on the Main Sequence. This is probably a good assumption for MQ Peg and MX Peg whose light curve, color, and period are consistent with a contact system with stellar radii approximately equal to the equivalent Main Sequence stars. The observed colors and longer periods of J180636 and V883 Her, however, suggest that one or both components in these systems are extended stars (radii 40-50 percent greater than Main Sequence equivalents). Given the above assumptions, two uncertainties in temperature were determined: the first from the uncertainties in eclipse depths and the second from the uncertainty in the corrected $B-V$ color. Again, given the above assumptions, the uncertainty in mass ratio was determined from the uncertainties in eclipse depths only (the effect of the uncertainty in the $B-V$ color on the mass ratio is negligible). We simultaneously adjusted the fillout factor and inclination to reproduce the observed light curve and list the best fit value and ranges qualitatively estimated by examining model fits. We modeled all stars using standard values for gravity darkening coefficients (1.00 for radiative stars of T > 7200 K and 0.32 for convective stars), limb darkening coefficients (from Appendix III in Bradstreet 1993) and reflection coefficients (1.0 for radiative stars and 0.5 for convective stars) and assumed there was no third light contribution. Table 2 summarizes the results.

Table 2: Preliminary Solutions

	J180616	V883 Her	V507 Lyr	MQ Peg	MX Peg
T_P (K)	7390 ± 40,70	7110 ± 130,60	6800 ± 260	6535 ± 60,20	6130 ± 80,180
T_S (K)	5900 ± 40,60	6720 ± 130,60	6800 ± 260	6480 ± 60,20	5990 ± 80,180
$massratio$	0.621 ± 0.007	0.876 ± 0.033	0.24 ± 0.01	0.984 ± 0.017	0.959 ± 0.022
$fillout$	0.1 (0.0 - 0.3)	0.1 (0.0 - 0.15)	0.2 (0.1 - 0.4)	0.1 (0.0 - 0.35)	0.0 (0.0 - 0.1)
$inclination$	66°(68°- 64°)	54°(56°- 53°)	80°(84°- 76°)	59°(61°- 51°)	62°(62°- 60°)

Notes on individual stars:

J180616 is listed in Akerlof et al. 2000 as a W UMa eclipsing system with a period of 0.65998(23) days. The best period determined using the CTI and AFA V data is 0.6600655(20) days. There is evidence of possible star spot activity in the AFA photometry (see phases 0.6 to 0.9 in Figure 1) where a single night of V observations was approximately 0.05 magnitudes fainter than during other observations.

V883 Her's period is listed in W96 (using previously reported CTI and CAP (1994) V data) as 0.695000(3) days (uncertainty originally not published). The new CAP (1996) V data slightly modifies this period to 0.695002(3) days. The new AFA V data, however, is systematically shifted later by about 1.1 hours. The best period determined using the new CAP (1996) and AFA V data is 0.695016(3) days with now the CTI data offset. No systematic timing error is known in any of the data, and so this may indicate that V883 Her's period is changing. If real, this implies a period increase of about 8.6 ± 2.3 seconds/century. This is extraordinarily large, but of the same order of magnitude as some other W UMa stars (see Molik and Wolf 1998). Clearly further more precise observations are warranted. Using the latter period and the minima listed in Table 3, the $O-C$ plot in Figure 6a illustrates this possible period increase.

V507 Lyr's period is listed in W96 as 0.366912(1) days. The new CAP (1996) V data fits this period well while the new AFA V data is systematically shifted, this time earlier by about 15 minutes. The best period determined by CAP and AFA V data is 0.3669098(10) days. Again, if real, this implies a period decrease of about 1.0 ± 0.8 seconds/century. Using the latter period and the minima listed in Table 3, the $O-C$ plot in Figure 6b illustrates this possible period decrease.

MQ Peg's period is listed in W96 as 0.379380(3) days. The new CAP (1995) V data refines this slightly to 0.3793785(15) days. The new AFA V data is again systematically shifted, this time later by about 30 minutes. The best period determined by CAP and AFA V data is 0.3793826(15) days. Again, if real, this implies a possible period increase of about 2.2 ± 1.1 seconds/century. Using the latter period and the minima listed in Table 3, the $O-C$ plot in Figure 6c illustrates this possible period increase.

MX Peg's period is listed in W96 as 0.394387(3) days. The new CAP (1996) V data and AFA V data refined this slightly to 0.3943902(20) days.

Acknowledgements:
We thank the Appalachian College Association for their support of this research. This research made use of the SIMBAD database, operated at CDS, Strasbourg, France.

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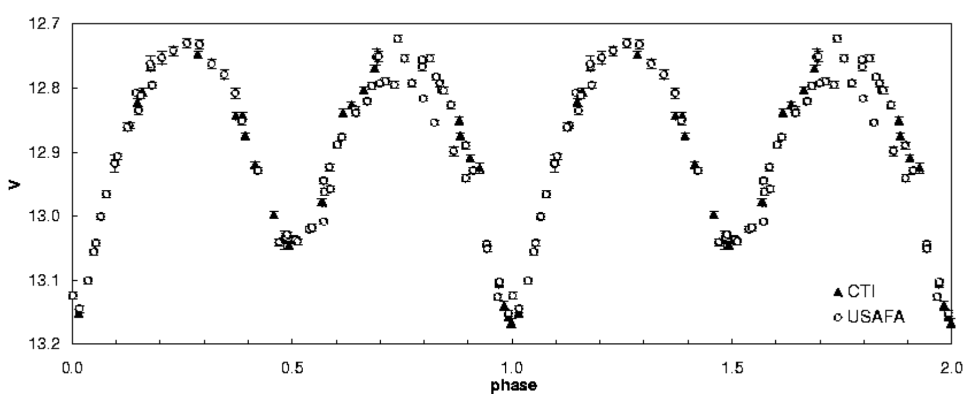

Figure 1. Light curve for J180616: P = 0.6600655 days, epoch = 2452906.674 HJD

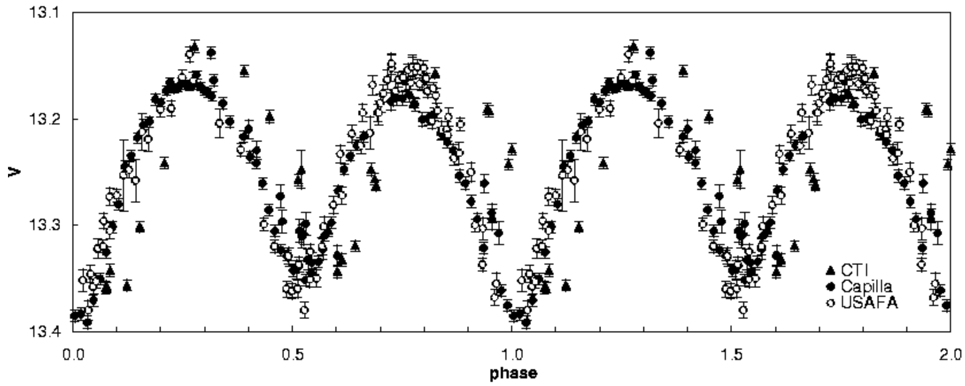

Figure 2. Light curve for V883 Her: P = 0.695016 days, epoch = 2452843.788 HJD

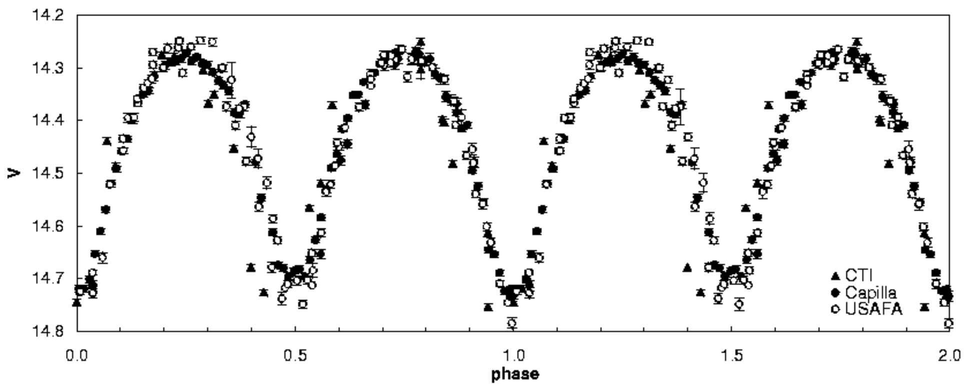

Figure 3. Light curve for V507 Lyr: P = 0.3669098 days, epoch = 2452865.694 HJD

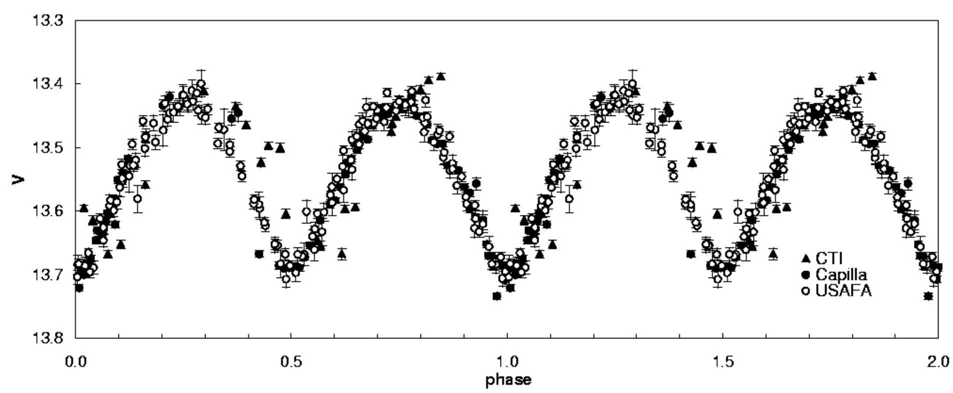

Figure 4. Light curve for MQ Peg: P = 0.3793826 days, epoch = 2452901.8527 HJD

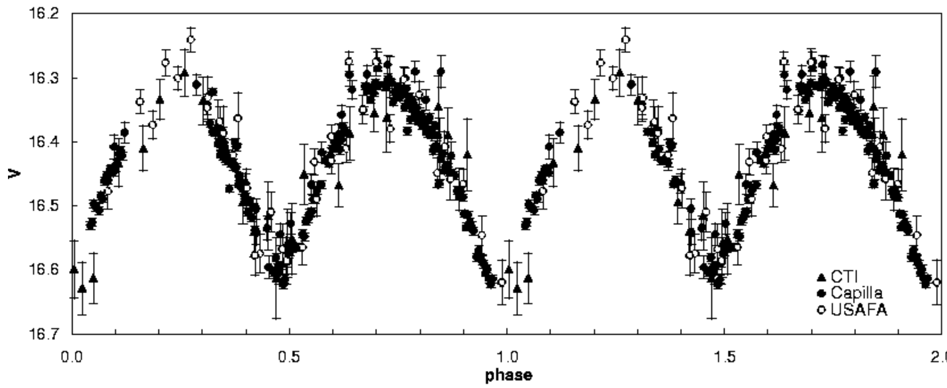

Figure 5. Light curve for MX Peg: P = 0.3943902 days, epoch = 2452872.955 HJD

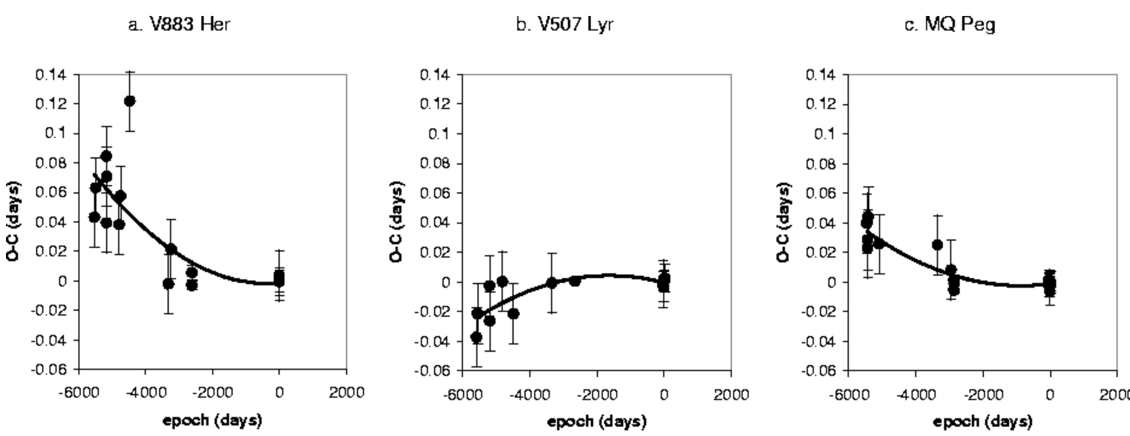

Figure 6. O-C plots for V883 Her, V507 Lyr, and MQ Peg (solid lines are non-weighted quadradic fits)

Table 3: Minima Timings

HJD	type	HJD	type
J180616		2452842.7594(28)	secondary
2447320.852(20)	secondary	2452843.860(10)	secondary
2447322.856(20)	secondary	2452844.7772(27)	primary
2447323.844(20)	primary	2452864.779(5)	secondary
2447643.965(20)	primary	2452865.694(5)	primary
2447688.845(20)	primary	2452878.721(6)	secondary
2447100.719(20)	primary	2452884.776(9)	primary
2448101.717(20)	secondary	**MQ Peg**	
2452830.760(12)	primary	2447443.715(20)	primary
2452833.732(19)	secondary	2447466.651(20)	secondary
2452834.719(12)	primary	2447470.640(20)	primary
2452866.7340(25)	secondary	2447482.606(20)	secondary
2452906.674(4)	primary	2447807.718(20)	secondary
V883 Her		2449545.859(20)	primary
2447319.844(20)	primary	2449952.920(20)	primary
2447357.742(20)	secondary	2450036.5601(15)	secondary
2447678.861(20)	secondary	2450036.7566(20)	primary
2447679.858(20)	primary	2450041.6865(18)	primary
2447686.840(20)	primary	2452864.861(5)	secondary
2448062.811(20)	primary	2452865.813(4)	primary
2448100.709(20)	secondary	2452866.760(6)	secondary
2448381.907(20)	secondary	2452871.691(9)	secondary
2449528.907(20)	secondary	2452871.882(5)	primary
2449611.637(20)	secondary	2452878.710(4)	primary
2450228.796(5)	secondary	2452894.644(4)	primary
2450229.8298(25)	primary	2452894.828(9)	secondary
2452842.745(9)	secondary	2452901.6607(14)	secondary
2452843.788(7)	primary	2452901.8527(23)	primary
2452844.834(17)	secondary	2452907.733(7)	secondary
V507 Lyr		**MX Peg**	
2447293.948(20)	secondary	2447466.673(20)	primary
2447323.867(20)	primary	2447482.630(20)	secondary
2447680.889(20)	primary	2447500.581(20)	primary
2447682.883(20)	secondary	2448126.865(20)	primary
2448062.845(20)	primary	2448212.631(20)	secondary
2448391.941(20)	primary	2449610.747(20)	secondary
2449538.922(20)	primary	2449634.804(9)	secondary
2450218.8071(22)	primary	2452872.758(8)	secondary
2452838.725(16)	secondary		

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TIMES OF MINIMA FOR SOME ECLIPSING BINARIES

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Observatory and telescope:
48 cm Cassegrain telescope and 30 cm Schmidt-Cassegrain telescope at Ege University Observatory (EUO)

Detector:	SSP-5 photometer including Hamamatsu R4457 photomultiplier and High-Speed Three-Channel Photometer including Hamamatsu R1436P photomultiplier.

Method of data reduction:
The differential magnitudes were corrected for atmospheric extinction and the observing times were reduced to the Sun's center.

Method of minimum determination:
The times of minima were computed using the Kwee and van Woerden method (Kwee and van Woerden 1956) as implemented in AVE[1].

Observed star(s):

Star name	GCVS type	Coordinates (J2000) RA	Dec	Comp. star	Ephemeris E 2400000+	P [day]	Source
ET Boo	EB	14 59 20.32	+46 49 03.6	SAO 45325	48500.4420	0.645046	1
DE CVn	E	13 26 54.30	+45 32 55.0	BD+45 2109	50550.9246	0.364095	3
KR Cyg	EA	20 09 05.60	+30 33 01.3	HD 191398	51363.4875	0.8451572	6
YY Gem	EA	07 34 37.41	+31 52 09.8	BD+32 1585	24595.8177	0.81428229	7
MM Her	EA	17 58 38.52	+22 08 46.8	HD 341480	45551.4274	7.960326	8
FS Leo	EB?	11 27 58.52	+14 49 55.5	BD+15 2333	51660.2706	0.456971	4
RW Tau	EA	04 03 54.32	+28 07 33.5	HD 25626	47525.4486	2.768827318	5
V1123 Tau	EB	03 34 58.55	+17 42 38.0	BD+17 567	48500.3570	0.399957	1
HD 162905	EW	17 53 32.26	−03 54 55.3	HD 162776	52369.9500	0.42651	9
HD 170451	EW	18 29 13.01	+06 47 13.7	HD 170291	52454.7107	0.375296	2

Source(s) of the ephemeris:
1.: ESA, 1997; 2.: Koppelman et al., 2002; 3.: Robb R.M., Greimel R., 1997; 4.: Rucinski et al., 2002; 5.: Simon, V., 1997; 6.: Sipahi E., Gulmen O., 2000., 7.: Sowell et al. 2001, 8.: Tas, G., 2000; 9.: Wils P., Dvorak S.W., 2003.

[1]AVE is written by Rafeal Barbera (`http://www.astrogea.org/soft/ave/introave.htm`).

Times of minima:

Star name	Time of min. HJD 2400000+	Error	Type	Filter	$O-C$ [day]	Rem.
ET Boo	52758.3580	2	I	B,V	−0.0327	
	52777.3861	4	II	B,V	−0.0334	
	52797.3825	3	II	B,V	−0.0334	
	52798.3510	2	I	B,V	−0.0325	
DE CVn	52411.3156	1	I	V	−0.1344	
	52412.4078	22	I	B,V,R	−0.1345	
	52413.4958	4	I	V	−0.1388	
	52705.5359	3	I	V,R	−0.1030	
	52727.3837	4	I	B,V,R	−0.1008	
KR Cyg	52832.3635	4	I	U,B,V,R	−0.0072	
	52859.4074	4	I	U,B,V,R	−0.0083	
	53192.4000	1	I	U,B,V,R	−0.0077	
YY Gem	52620.5625	0	II	V	−0.0016	
	52965.4134	1	I	B,V	0.0007	
	52978.4421	1	I	B,V	0.0009	
	53046.4338	1	II	B,V	−0.00002	
	53082.2603	2	II	B,V	−0.0019	
MM Her	51752.4992	12	I	U,B,V,R	−0.0221	
	51760.4776	27	I	U,B,V,R	−0.0041	
	51776.3818	9	I	U,B,V,R	−0.0205	
	52349.5390	11	I	B,V,R	−0.0068	
	52767.4563	7	II	U,B,V,R	−0.0066	
	52771.4332	7	I	U,B,V,R	−0.0099	
	53169.4508	7	I	U,B,V,R	−0.0086	
FS Leo	52322.4207	2	I	B,V	−0.0009	
	52323.3349	6	I	B,V	−0.0006	
	52353.4921	3	I	B,V	−0.0036	
	52364.4640	3	I	B,V	0.0011	
	52391.4222	8	I	B,V	−0.0020	
	52397.3629	1	I	B,V	−0.0019	
	52399.4204	4	II	B,V	−0.0008	
	52692.3397	3	II	B	0.0001	
	52697.3654	7	II	B,V	−0.0009	
	52697.5918	5	I	B,V	−0.0030	
	52698.5051	3	I	B,V	−0.0036	
RW Tau	52193.5708	2	I	U,B,V,R	−0.1207	
	52229.5653	1	I	U,B,V,R	−0.1209	
	52232.3345	5	I	U,B,V,R	−0.1205	
V1123 Tau	52591.4541	1	I	B,V	−0.0630	
	52963.4075	3	I	U,B,V,R	−0.0696	
	52964.4052	3	II	U,B,V,R	−0.0718	
	52976.4034	5	II	U,B,V,R	−0.0724	
	53001.4001	3	I	U,B,V,R	−0.0730	
HD 162905	52849.3465	8	I	U,B,V,R	−0.0008	
	52822.4713	3	I	U,B,V,R	−0.0059	
HD 170451	52798.4949	5	I	U,B,V,R	0.0131	
	52802.4350	4	II	U,B,V,R	0.0125	
	52795.4934	4	I	U,B,V,R	0.0139	

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MISIDENTIFIED AND MISSING SOUTHERN ECLIPSING BINARIES

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As described in Dvorak (2004), a set of 442 eclipsing binaries was selected from the GCVS catalog (Kholopov 2003) that had declination < 0, minimum magnitude brighter than 13.0, and no published times of minima later than JD 2440000 available through the NASA ADS service. Analysis of this data in Dvorak (2004) revealed that 327 stars (74.0%) matched the information in the GCVS catalog reasonably well. Another 85 stars (19.2%) were identified correctly but had radically different periods.

Of the remaining 30 stars, no match in the ASAS-3 data was found for 20 stars (4.5%). All stars within 10' radius of the position listed in the online GCVS catalog that had at least 100 observations and were no more than 1.5 magnitudes fainter than the GCVS maximum were examined. These stars are listed in Table 1, and are also available electronically on the IBVS web server.

An additional 7 stars (1.6%) were mis-classified in the GCVS catalog. Examination of the light curves from the ASAS-3 data revealed that these objects were not eclipsing binaries: 4 were RR Lyraes and 3 were tentatively identified as semi-regular variables. These stars are listed in Table 2 and again are available electronically from the IBVS web site.

The remaining 3 stars (0.7%) are mis-identified in the GCVS catalog. The positions listed for these stars in the GCVS are incorrect; the correct stars were determined by searching a 10' radius around the published position for a star matching the range and period listed in the GCVS. This data is listed in Table 3 and available from the IBVS web site.

Table 1. Missing eclipsing binaries.

Star Name	GCVS Range	GCVS Period(d)	GCVS Type
YY Car	10.0-11.5	2.64264	EA/SD
BP Car*	11.5-12.5	9.64492	EA/DS
CD Car	12.0-12.9	2.96756	EA
FS Car*	10.8-11.5	2.146587	EB
GG Car	9.1-9.5	62.086	EB/GS
GV Car*	8.92-9.32	4.294621	EA/DM
RR Col	10.2-10.7	11.305	EA
RS Crt	11.21-11.9	0.8168	EA
AY Mus	10.51-10.8	3.205558	EA/DM
SW Nor	10.5-12.0	29.6349	EA/DS
SX Nor*	12.1-12.2	3.74008	EA
TT Nor	12.6-12.9	37.246	EA/D
UW Nor*	12.0-12.7	8.48601	EA/DS:
VV Nor	12.1-12.3	1.10175	EA
CY Oph*	10.8-11.7	24.5	EA/DS:
V0604 Sco*	12.1-12.4	1.53789	EA/D:
V1108 Sgr*	11.6-12.8	46.5816	EA/DS
V1721 Sgr*	10.4-10.6	1.788564	EA/DM
EP TrA*	9.4-9.9	2.14165	EA/D
CK Vel	10.0-10.6	35.009	EA

*Notes on individual stars:
BP Car = rich star field
FS Car = close to bright star - photometry suspect; Nearby variables: BC Car (ASAS 103732-5900.6) LPV: 10.5-11.5; VV Car (ASAS 103826-5912.4) Irr 11.3-12.5
GV Car = rich field; close companion to GCVS star
SX Nor = matched star is 13.3mag; light curve noisy
UW Nor = matched star mag = 13.4
CY Oph = close companion to GCVS star
V0604 Sco = Nearby variable: V0610 Sco (ASAS 170642-3952.3) SR: 11.6-12.1 p 100d
V1108 Sgr = Nearby variable: ASAS 191203-1758.6 SR 11.7-11.9 p 85d
V1721 Sgr = close companion to GCVS star
EP TrA = nearby EO TrA has almost identical period - probably a duplicate entry

Table 2. Incorrectly classified variable stars.

Star Name	GCVS Range	GCVS Period(d)	GCVS Type	ASAS Period(d)	ASAS Epoch	ASAS Range (V)	New Type
FL Car	12.5-12.8	0.92576	EA	204:		11.6-12.0	SR
V0746 Cen	11.5-12.5	5.21035	E/SD:	0.5514	3087.73	10.2-10.9	RRAB
AW Gru	10.5-11.0	120	E:	80:		8.30-8.90	SR
BF Gru	11.2-11.8	55.8	E:	75:		10.5-11.5	SR
HH Nor	10.3-11.5	8.58313	EA/DS	0.598275	2093.53	8.6-9.0	RRAB
RU Sex*	10.6-11.4	13.07	EB:	0.350225	2226.834	10.6-11.1	RRAB
V1643 Sgr	11.8-12.1	0.679456	EW:	0.33956	2721.85	11.9-12.3	RR

*Notes on individual stars:
RU Sex = previously identified as an RR Lyrae by Brelstaff and Isles (1986) and Williams (1993)

Table 3. Incorrectly identified eclipsing binaries.

Star Name	GCVS Range	GCVS Period(d)	Updated Period(d)	Updated Epoch	ASAS-3 (V mag) Pri Range	ASAS-3 (V mag) Sec Range	GSC ID
V0673 Cen	10.3-10.5	0.932792	0.93266	2038.641	10.0-10.4	10.0-10.1	8271-688
EV Lup	9.8-12.5	15.312	15.31	2033.65	10.9-12.5	< 0.1	7834-1571
V3886 Sgr	11.5-12.3	1.407685	1.4077	2171.579	11.3-12.6	11.3-11.5	7492-3038

Acknowledgements: This research has made use of NASA's Astrophysics Data System Bibliographic Services, and the All Sky Automated Survey database (`http://www.astrouw.edu.pl/~gp/asas/asas.html`).

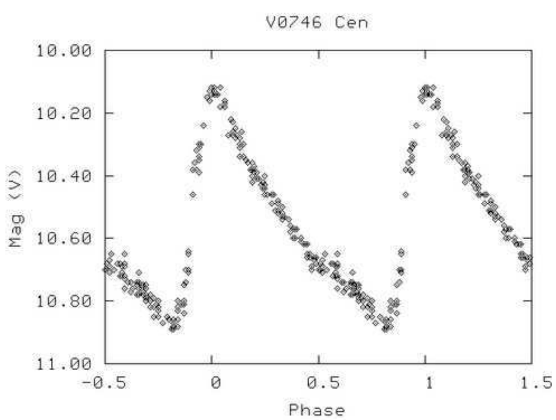

Figure 1.

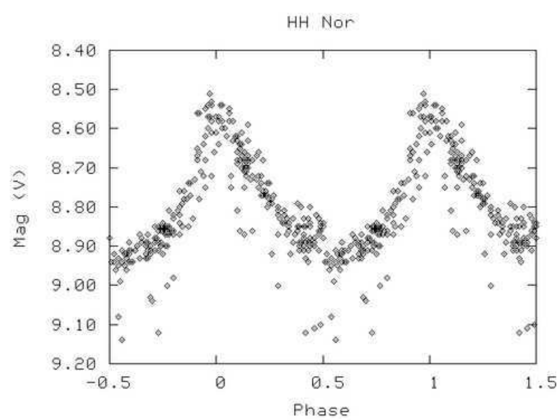

Figure 2.

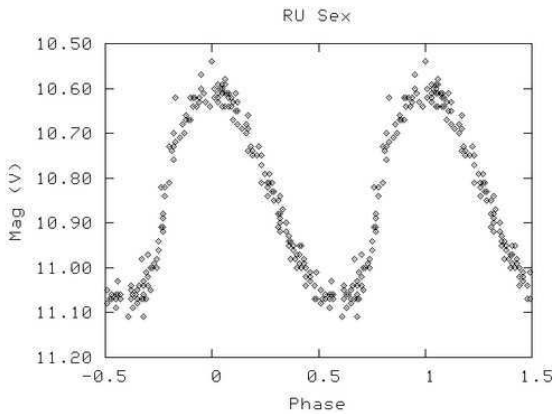

Figure 3.

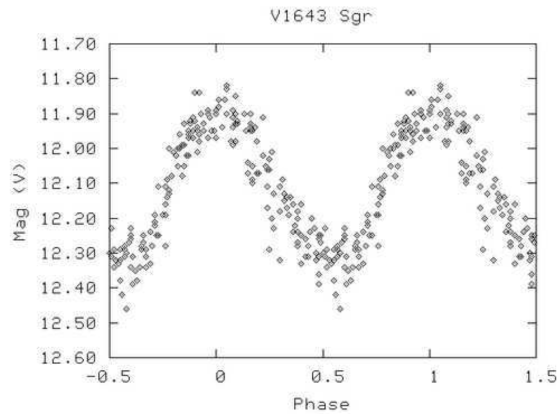

Figure 4.

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ERRATUM FOR IBVS 5549

There is a typographical error in the GSC identification of V3886 Sgr as listed in IBVS 5549. The article identified the variable as GSC 7492 3038. The correct identification is GSC 7942 3038.

Shawn Dvorak

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CCD PHOTOMETRY OF FIVE FAINT CATACLYSMIC VARIABLES

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Photometric observations of several faint cataclysmic variables were obtained in Aug. 1994 using the CCD camera on the 0.9m Dutch telescope at the European Southern Observatory (La Silla) to search for orbital variability and eclipses. Differential instrumental magnitudes were then derived relative to nearby comparison stars on the same CCD image. This note presents results for some of the targets for which no photometric time series exist to date and gives additional information for a recently established SU UMa variable. Table 1 lists the observing log.

Table 1: Journal of observations. The measurements were performed in integral light. Classifications and magnitudes are from the on-line data catalog by Downes et al. (2001) and literature cited therein. Start is the time for the midpoint of the first exposure.

Object	Type	Date	Start (UT)	Duration (h)	Int. Time (m)	Frames (No.)	Mag
FV Ara	UG	1994 Aug. 14	23:31	1.92	4	25	18p
NSV 13783	NL?	1994 Aug. 16	01:28	2.58	4	33	19p
NSV 14292	NL?	1994 Aug. 15	03:42	2.65	4	35	19.2p
V604 Aql	NA	1994 Aug. 13	00:35	3:30	4	42	19.6v
V1141 Aql	UGSU	1994 Aug. 11	00:29	3.07	5/7	30	19.5v

FV Ara

Based on its outburst behaviour this object has recently been suggested to be a candidate for a WZ Sge-type dwarf nova (Kato et al. 2001). Bateson (1998) reported that FV Ara may have intervals of inactivity where in active phases the outburst cycle is on the order of 15 days. During the present observations the object was quiescent. It showed no obvious variability exceeding the 0.03 mag level, i.e. the behaviour of constant nearby stars of the same brightness.

NSV 13783, NSV 14292

Both objects were tentatively classified as nova-like variables by Vogt (1989). Whereas NSV 13783 showed nearly constant behaviour with the scatter of measurements being of the same order as those of nearby stars of the same brightness, the measurements of NSV 14292 indicate some kind of flickering activity (scatter enhanced by a factor of 3 as compared to constant stars).

V604 Aql

The outburst light curve of the fast nova V604 Aql (Nova Aquilae 1905) was recorded by Walker (1923). Features of the outburst spectra were described by Moore (1906) and Cannon (1916). The object was revisited by Szkody (1994) who reports BVRJK magnitudes for the postnova. The present light curve exhibits variations with up to about 0.45 mag which might be caused by flaring events or partly by the appearance of an orbital hump (Fig. 1).

V1141 Aql

Based on the appearance of humps during a superoutburst this object has recently been classified by Olech (2003) as a member of the SU UMa class of dwarf novae. A spectrum obtained by Mason & Howell (2003) during minimum light shows large double peaked emission lines indicating a high orbital inclination. The photometric observations presented here were also performed during minimum light. They reveal the existence of pronounced orbital humps with an amplitude of about 0.4 mag and indicate an intermediate hump structure (Fig. 2). Eclipses are obviously not present. The data can be best fitted with a period of 89.31 min. Given the superhump period of 85.39 min (Olech 2003) one would expect an orbital period of the order of 84 min. But the present data set is too sparse to draw any definitive conclusion (Fig. 3). Further, it is worthwhile to note that the image of V1141 Aql is contaminated by a faint background star (Fig. 4).

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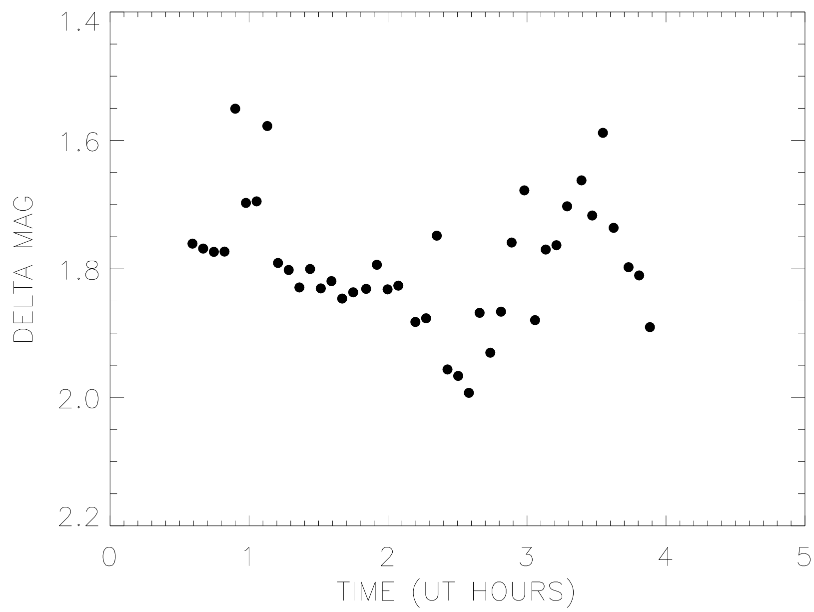

Figure 1. Differential photometry of V604 Aql obtained in integral light on 1994 Aug. 13. Flaring events as well as a possible hump structure are recognizable.

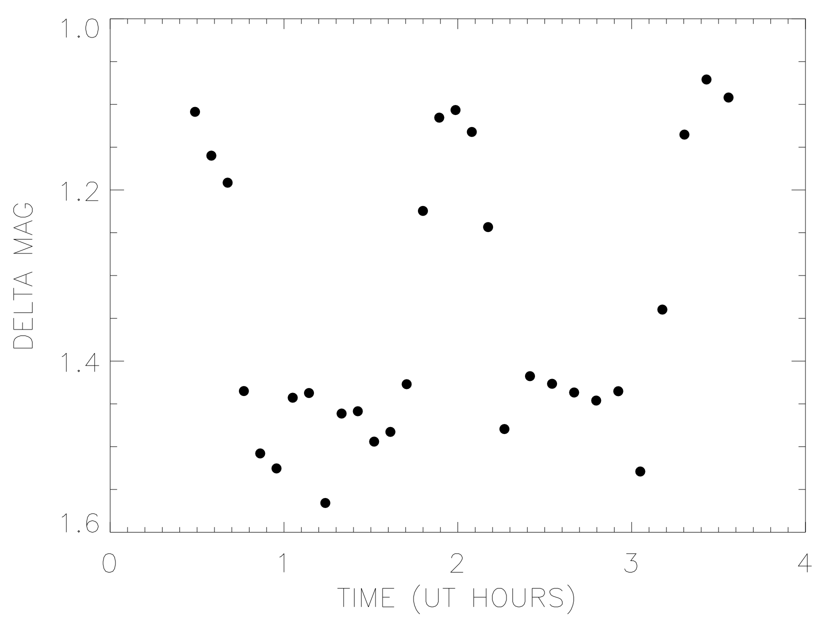

Figure 2. Differential photometry of V1141 Aql obtained in integral light on 1994 Aug. 11. The system is at minimum light and shows pronounced orbital humps. At 2:21 UT the integration time of 5 min was changed to 7 min.

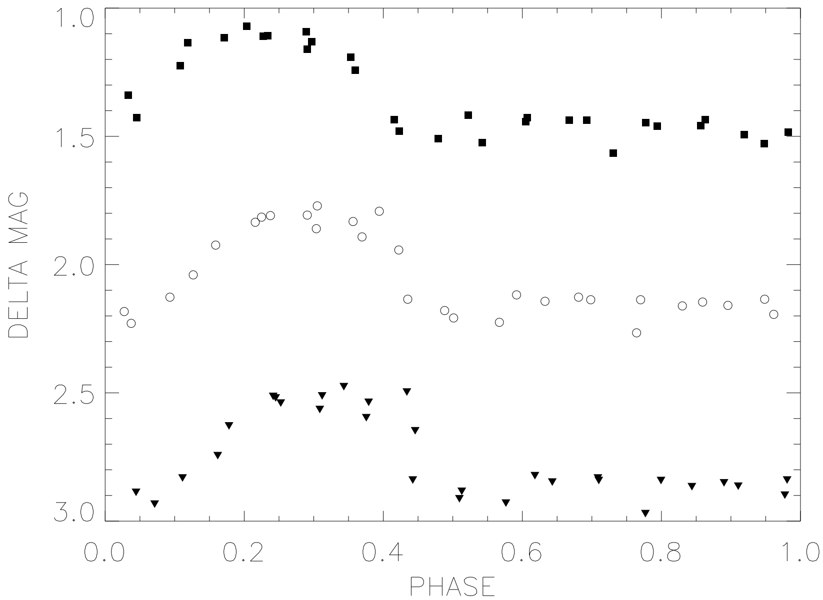

Figure 3. The photometric measurements of V1141 Aql folded with different periods: (1) 89.31 min as suggested by a periodogram analysis (top), (2) 85.39 min as given by Olech (2003) for the superhump period (middle), (3) 84.0 min as suggested by Olech (2003) for the orbital period (bottom). Phase zero is arbitrary.

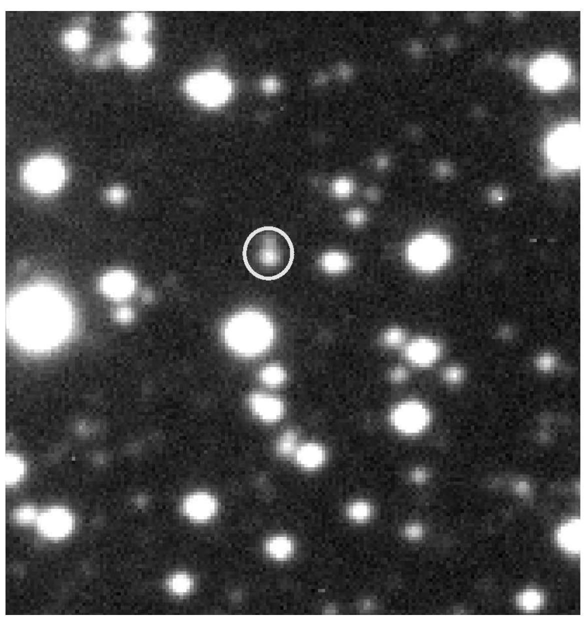

Figure 4. The field around V1141 Aql (N is at top, E to the left) during the 1994 observations. The variable (marked by a circle) is estimated to be at about 19 mag, i.e. at minimum brightness. During Olech's measurements its brightness was comparable to that of the 15 mag star to the SSE of V1141 Aql. Note that the image of V1141 Aql is contaminated by a faint background star which was previously not known.

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HD 173844, A NEW δ SCUTI STAR

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A large fraction of low amplitude pulsators are discovered serendipitously when they are chosen as comparison stars for other programs. This is the case for HD 173844 (A2, V=$8\overset{m}{.}70$), which was originally used as the comparison star of the ellipsoidal δ Scuti star HD 173977 (Chapellier et al. 2004).

Photometric observations were obtained in August and September 2001 at the 0.9 photometric telescope of the Sierra Nevada Observatory (Spain) and at the 1.5 m telescope at San Pedro Martir Observatory (Mexico). Both sites have a 4-channel multicolor Strömgren spectro-photometer. HD 173633 (A2, V=$8\overset{m}{.}43$) was used as comparison star. We obtained 69 measurements spread over 48 days in the four u, v, b, y filters. Note that in the following, the data obtained in the u-filter have not been considered because of a too large dispersion.

We obtained another more homogeneous data set from San Pedro Martir in 2002, representing 156 measurements over 14 consecutive nights.

A Fourier analysis of the different filters lead to the detection of a clear signal for a frequency $f = 15.79\,\mathrm{d}^{-1}$ (Fig. 1).

A non-linear sine-fit provided the parameters given in Table 1.

Table 1. Results of the sine-fit analysis performed to the Strömgren photometric data. For the different filters are given the dominant frequency f [d^{-1}], the corresponding amplitudes A [mmag], residuals [mmag] and fraction of the variance [%].

filter	f	A	res	var
v	15.792	4.5	4.9	31
b	15.793	4.1	4.5	28
y	15.794	3.2	4.5	19

The light curve recorded in the v-filter is represented in Fig. 2.

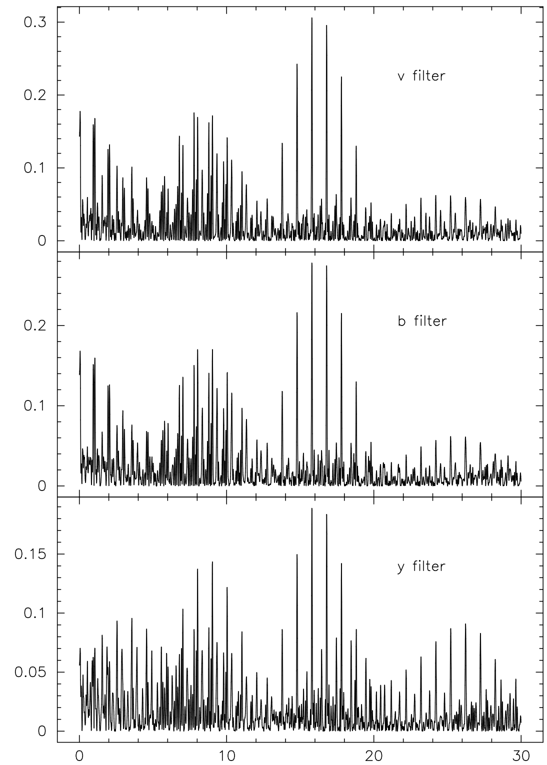

Figure 1. Amplitude spectra in the different filters.

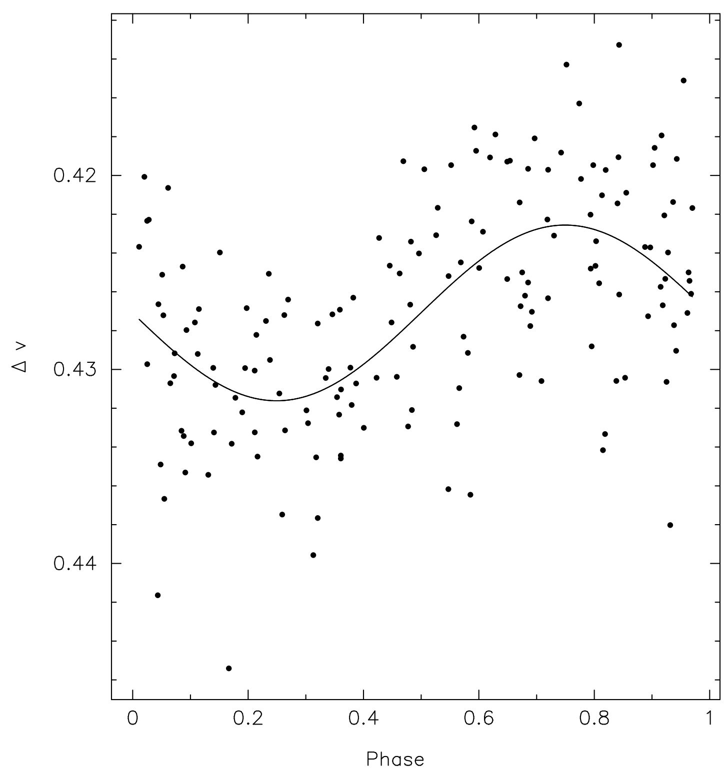

Figure 2. v-filter photometric magnitudes data phased with the frequency $f = 15.79\,\mathrm{d}^{-1}$.

The large dispersion of the curve, the relatively high residuals and low values of the fraction of the variance suggest that additional frequencies are present. A prewhitening of the data for the f frequency in the different filters data leads to periodograms where much of the amplitude is in the low frequency region, but also shows signal around a 9.04^{-1} (Fig. 3).

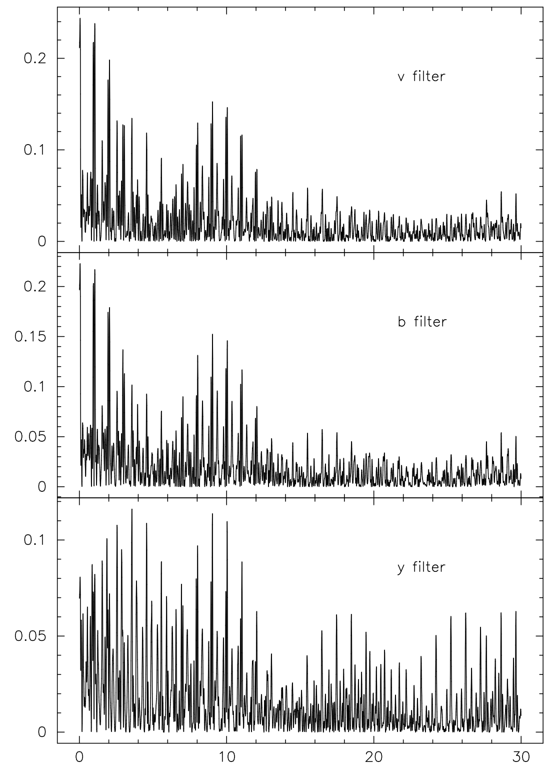

Figure 3. Amplitude spectra in the different filters, once the f frequency has been prewhitened.

Considering only the v-filter, associated with the largest amplitude, shows that a sine-fit with the f and 9.04^{-1} frequencies accounts for only 40 % of the fraction of the variance.

As a conclusion, HD 173844 should be considered as a new δ Scuti star, a status compatible with both its A2 spectral type and variability timescale. New, extensive data are necessary to determine its complete variability properties.

Reference:

Chapellier, E., Mathias, P., Le Contel, J.-M., et al., 2004, A&A, in press

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Brh V128 IS A DOUBLE-MODE HIGH-AMPLITUDE δ SCUTI STAR

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The star Brh V128 (= GSC 1893-89; $\alpha_{2000} = 06^{\mathrm{h}}44^{\mathrm{m}}01\overset{\mathrm{s}}{.}06$; $\delta_{2000} = +22^\circ 44' 31\overset{''}{.}7$) was detected as a short period variable by Bernhard (2003).

The star was subsequently monitored by the authors from observatories across Europe. The instruments used were 20-cm Cassegrain telescopes equipped with a Startlight Xpress SX CCD-camera (KB), an SBIG ST-7 (WQ) and an ST-6 (WP), and 40-cm Newtonian telescopes with an SBIG ST-7 (OP) and an ST10 XME camera (PVC). KB and WP observed unfiltered, all other observers used a V filter. OP additionally observed two nights in R_c and I_c. Comparison star magnitudes were derived from the ASAS3 database (Pojmanski, 2002). The data are available electronically through the IBVS website as `5552-t2.txt`.

The observations showed that Brh V128 is a pulsating variable with a total amplitude of about 0.4 mag and two peaks in the periodogram, at 0.1177 and 0.1534 days. Folded light curves for these periods, after prewhitening for the other, are given in Figs. 1 and 2. V data are represented with filled circles, unfiltered data with open squares. The ratio between these periods is 0.7673 ± 0.0002, which makes this star a member of the rare group of radially pulsating double-mode HADS (Petersen and Christensen-Dalsgaard, 1996; McNamara, 2000). Recently found examples include V575 Lyr (Van Cauteren and Wils, 2001), BQ Ind (Sterken et al., 2002) and GSC 2583-504 (Wils et al., 2003).

Using the Fourier analysis program `Period98` (Sperl, 1998), other peaks at linear combinations of the main frequencies were found as well, see Table 1 for an overview. Note that the amplitude of the first overtone frequency f_1 is slightly larger than that of the fundamental mode f_0, unlike in most other double-mode HADS.

The proper motion of Brh V128 is small, 0.2 mas/y in RA and -1.6 mas/y in declination, according to UCAC2 (Zacharias et al., 2004). Together with the rather long period, this makes it an unlikely candidate to be an SX Phe star, but rather a Population I object.

Fig. 3 gives the Petersen diagram for the known double-mode HADS in the Milky Way, with data from the literature. The open square indicates the position of Brh V128.

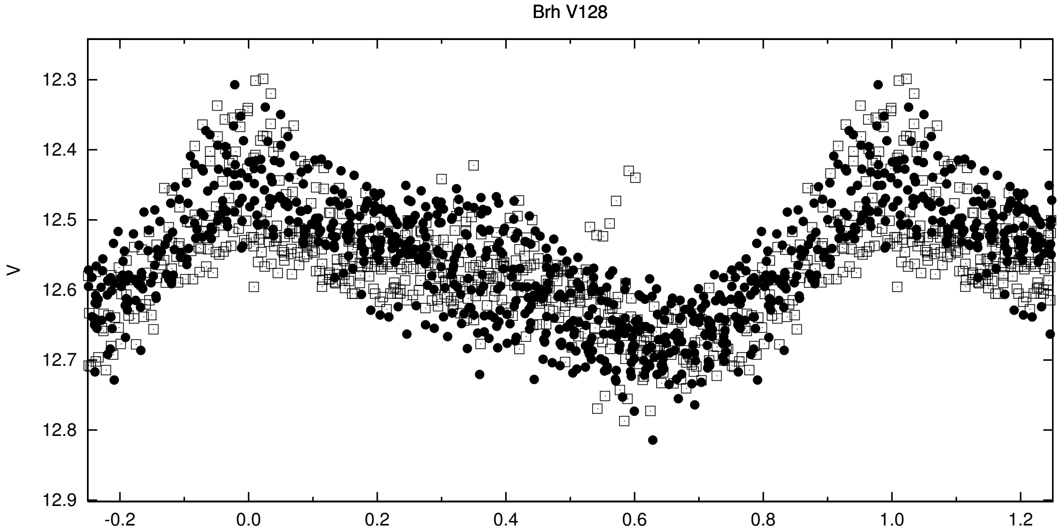

Figure 1. Phase plot for the first overtone period of 0.1177 days, after prewhitening for the fundamental period.

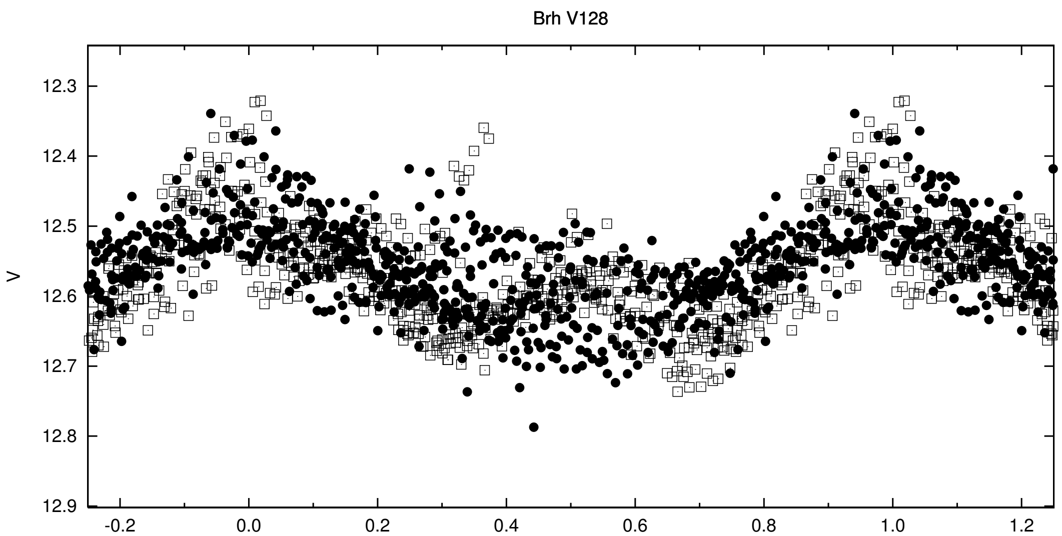

Figure 2. Phase plot for the fundamental period of 0.1534 days, after prewhitening for the first overtone.

Table 1. Frequencies detected in Brh V128

Mode	Frequency (c/d)	Semi-amplitude (mag)	Phase
f_1	8.497 ± 0.001	0.10	0.96
f_0	6.519 ± 0.001	0.07	0.71
$f_0 + f_1$	15.016 ± 0.001	0.03	0.14
$2f_1$	16.993 ± 0.001	0.03	0.40

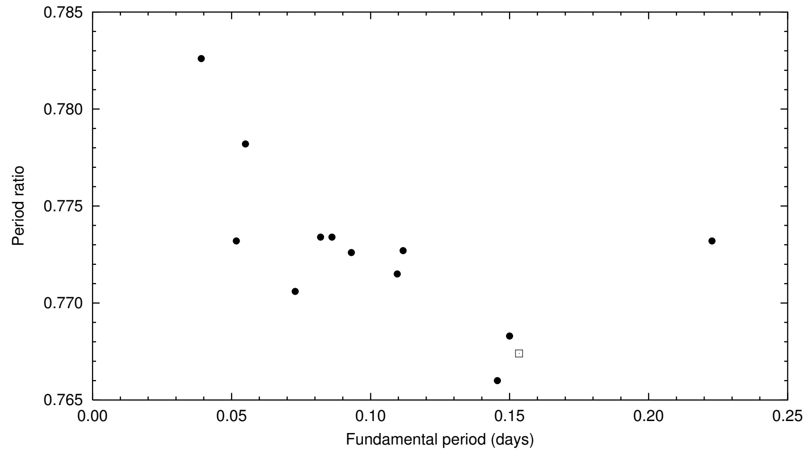

Figure 3. Petersen diagram for the Galactic double-mode HADS.

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HD 52452: NEW BVRI PHOTOMETRY

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HD 52452 (V369 Gem, SAO 78998; V = 8.05, $B-V$ = 0.67; G5 V) is one of the shortest period ($0\overset{\mathrm{d}}{.}42304$) non-eclipsing chromospherically active binary star discovered so far. Its X-ray properties were discovered in the ROSAT all sky survey program and it is one among 383 relatively bright X-ray sources cataloged by Pounds et al. (1993). The star HD 52452 is an optical counterpart of the EUV bright source RE J70222+255054 (Mason et al. 1995) and its photometric and spectroscopic observations aimed at the classification of EUV stellar sources detected by EXOSAT and ROSAT were carried by Cutispoto et al. (1999, 2000). Furthermore, HD 52452 is also listed in the 2RE source catalogue published by Pye et al. (1995). Messina et al. (2001) reported that HD 52452 is a triple system consisting of a tidally coupled G4 V + late-G SB1 (responsible for the most of the observed optical variability) and a G5 V companion. Their photometric observations reveal that the observed photometric variability is due to the presence of cool spots on the photospheres of both component of the SB1 system. In this paper we report the multi-band BVRI photometry of HD 52452.

The BVRI photoelectric photometric observations of HD 52452 were carried out during two observing runs - one during February 17 - March 23, 2000 for 8 nights and another one during February 20 - February 26, 2001 for 6 nights. For the first observing run we have a total of 158 data points and have 93 data points for the next one. The 40-cm Schmidt-Cassegrain LX 200 Meade telescope equipped with SSP-3A photoelectric photometer and Johnson standard broad-band BVRI filters were used for the observation. The telescope is situated on the campus of the Inter University Centre for Astronomy and Astrophysics (IUCAA) in Pune, India. The detector used in the SSP-3A photometer is a silicon PN-photodiode which is not cooled. The response function of the B, V, R and I filters with the detector closely match those of the Johnson standard filters. In order to obtain accurate differential photometry, we used two nearby stars HD 52071 (K2 III, $V = 7.11$, $B-V = 1.27$) as comparison star and HD 50692 (G0 V, $V = 5.76$, $B-V = 0.56$) as check star. The mean of four to five independent differential magnitudes per observation in each band were corrected for atmospheric extinction and transformed into BVRI standard system. No significant light variation was detected for the differential magnitudes of the comparison and check star ΔV_c, which is a good measure of the quality of our observation. The uncertainties in ΔV, $\Delta(B-V)$, $\Delta(V-R)$ and $\Delta(V-I)$ are 0.015, 0.02, 0.017 and 0.02 magnitudes, respectively.

The combined data for both 2000 and 2001 were analyzed to obtain the photometric period using a Scargle-Press period search routine (Scargle 1982, Horne & Baliunas

Table 1: Photometric periods for HD 52452

Data set	Period	FAP (%)
2000+Messina et al. (2001)	0.42402±0.00021	2.00
2001+Messina et al. (2001)	0.45163±0.00146	4.40
Combined (2000+2001)	0.42261±0.00002	5.68

Table 2: Results form photometric analysis of HD 52452

Epoch	JD interval	Minimum I	phase II	Maximum amplitude
2000.132	51592.144 - 51593.347	0.2	0.7	0.13
2000.193	51605.125 - 51608.304	0.2	0.7	0.24
2001.140	51961.140 - 51962.301	0.1	0.6	0.14
2001.147	51963.141 - 51964.211	0.1	0.6	0.16

1986), and a photometric period P = $0^{\rm d}.42261\pm0.00002$, with a false- alarm-probability FAP = 5.68 % was found. Photometric periods with error and false-alarm- probability (FAP in %) are listed in Table 1. To cross check our period search routine we also derived photometric period from Messina et al. (2001) data and a photometric period $0^{\rm d}.42309\pm0.00017$ with FAP 8.61 % was found which agrees well with the period ($0^{\rm d}.42304$) reported by Messina et al. (2001). The slightly larger period for the epoch 2001 with Messina et al. (2001) data as compared to the other epoch may be due to the scatter in the data covering long period.

Observed data points have been folded in to a phase using the photometric ephemeris HJD = 2449672.0 + $0^{\rm d}.42261 \times E$. We divided our photometric data points into four subsets (two for each epoch) and phase diagram for these subsets and associated colors $(B-V)$, $(V-R)$ and $(V-I)$ are shown in Figure 1 and 2 for the V band. The differential magnitudes of the check star with respect to the comparison star V_c are shown in the same diagrams. We have also shown the complete light curve for epoch 2000 and 2001 in the panel (c) of Figure 1 and 2 respectively. Table 2 gives the epoch, JD interval, the minimum phase and maximum amplitude for observed data points.

A significant variation in the light curve within the first year and between the two seasons from the phase diagrams is seen (Fig. 1 & 2). Small variations are observed for the epoch 2000.132 but the data points are very scattered. Visual inspection of light curve for the star HD 52452 reveals the existence of two minima separated from each other by about half period in phase. This behavior is possibly due to the existence of two spots on the stellar surface. The amplitude of light variation is ∼0.24 magnitude in V band for 2000.193, which is large compared to the ∼0.16 magnitude in V band reported by Messina et al. (2001). He also observed peaked light curve separated by 0.4 in phase. For the next observing epochs 2001.140 and 2001.147 the amplitude of light variation decreases to ∼0.14 and ∼0.16 magnitude in V band respectively.

The $(V-I)$ color curve for the epoch 2000.193 reveal the variation of ∼0.7 magnitude but except this, in general there are no significant variation for the $(B-V)$, $(V-R)$ and $(V-I)$ color indices. The observed variation in $(V-I)$ color index can be attributed to the lower spot temperature relative to the photosphere than in other cases. The present observations clearly suggests that the optical variability in the star HD 52452 is due to the presence of cool spots on the stellar surface.

The comparison of our data with previous observations reported by Messina et al. (2001) shows that there is a variation in amplitude, but the phases of the two minima, thus the positions of the spot, are quite stable during our observations. The very short photometric period makes this star very interesting for studying the evolution of spots on stellar surface in terms of spot parameters over a longer time period.

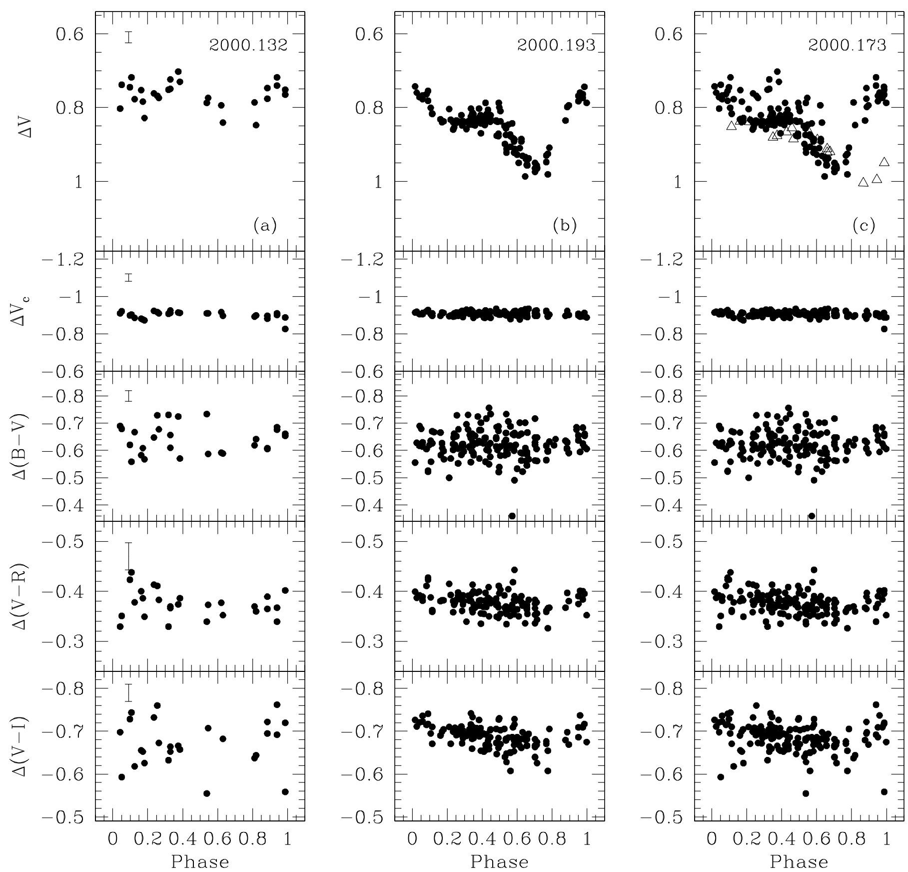

Figure 1. V band light curves and $(B-V), (V-R)$ and $(V-I)$ colors for HD 52452 for the observing run during February - March 2000. V_c for the check star observed on the same nights. Typical error bars are shown in the upper left corner of each light curve in panel (a). The open triangle denote the observations from Messina et al. (2001).

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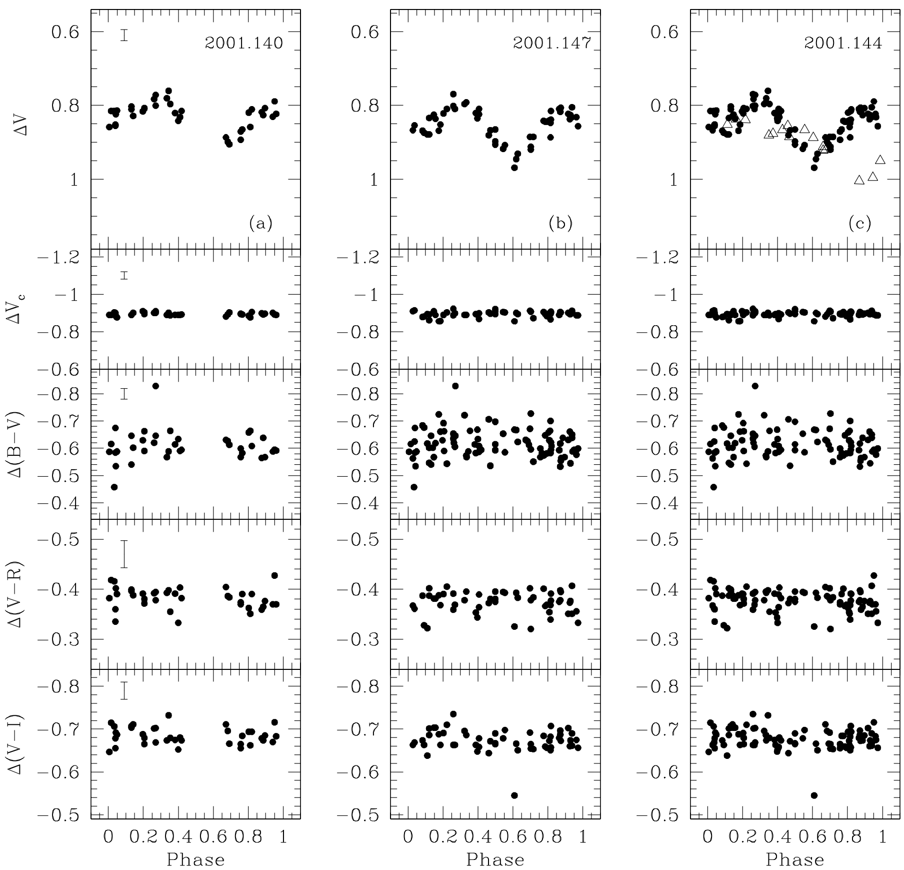

Figure 2. V band light curves and $(B-V),(V-R)$ and $(V-I)$ colors for HD 52452 for the observing run during February 2001. V$_c$ for the check star observed on the same nights. Typical error bars are shown in the upper left corner of each light curve in panel (a). The open triangle denote the observations from Messina et al. (2001).

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PHOTOMETRIC ANALYSES OF THE CONTACT BINARIES FZ ORIONIS AND AH TAURI

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Hoffmeister (1934) discovered variability in the light of **FZ Orionis** (HD 288166, GSC 119 01014, $\alpha(2000) = 05^{\rm h}41^{\rm m}21^{\rm s}$, $\delta(2000) = +02^\circ36'23''$). Kippenhahn (1953) classified the system to be of the type β Lyr, and estimated the period to be 1.597 days. Figer (1983) and Le Brogne *et al.* (1984) suggested the system was instead of the type W UMa and reported a period of 0.3999860 days. El-Bassuny Alaway(1993) and Rukmini *et al.* (2001) suggested that the variability in the light curve could be due to the presence of a third body and/or mass loss from the system.

Shapley *et al.* (1934) discovered variability in the light of **AH Tauri** (HBV 6187, CSI 24 3442, $\alpha(2000) = 03^{\rm h}47^{\rm m}12^{\rm s}$, $\delta(2000) = +25^\circ7'0''$). Photographic observations were made by Binnendijk (1950) and Romano (1962), Binnendijk classified the system as W UMa, while Romano classified the system to be of the type β Lyr. Further photometric observations were made by Bookmyer (1971) and Liu *et al.* (1991). Bookmyer indicated a spectral type of around G5. Liu gives a complete Wilson-Devinney solution.

Our photometric observations of FZ Ori were made on the nights of December 21 and 22, 2003, and of AH Tau on the nights of December 24, 30, and 31, 2003, using the 46-cm telescope with attached SBIG ST-8XE CCD camera equipped with standard Johnson UBVRI filters. The images were calibrated and the magnitudes extracted using standard image reduction procedures with MIRA. Differential magnitudes in the natural system are available upon request of author NLM. Approximately 200 observations were made in each of the R, I, and V filters of FZ Ori and 130 observations in these same filters of AH Tau. The comparison and check star data for FZ Ori were as follows: comparison star (GSC 00119-00214, $\alpha(2000) = 05^{\rm h}41^{\rm m}17\overset{\rm s}{.}6$, $\delta(2000) = +02^\circ35'30\overset{''}{.}0$); check star (GSC 00119-00771, $\alpha(2000) = 05^{\rm h}41^{\rm m}05\overset{\rm s}{.}1$, $\delta(2000) = +02^\circ37'12\overset{''}{.}0$). These stars are labeled in Figure 1 as C and K with the variable star denoted by V. The comparison and check star data for AH Tau were as follows: comparison star (GSC 01804-02470, $\alpha(2000) = 03^{\rm h}47^{\rm m}0\overset{\rm s}{.}0$, $\delta(2000) = +25^\circ5'29\overset{''}{.}0$); check star (GSC 01804-02485, $\alpha(2000) = 03^{\rm h}47^{\rm m}20\overset{\rm s}{.}0$, $\delta(2000) = +25^\circ8'36\overset{''}{.}0$). These stars are labeled in Figure 2 in the same sense as Figure 1.

We observed one primary and two secondary minima for FZ Ori and two primary and one secondary minima for AH Tau. The mean epochs of minimum light were determined from these eclipses using the results of parabolic fits. Table 1 contains the average times of minima for the three observed colors. Additional times of minima for FZ Ori were recorded by El-Bassuny, Le Brogne *et al.*, and Nelson (2004). Additional times of minima for AH Tau were recorded by Liu *et al.*. A linear ephemeris was calculated using the last 18,000 orbits (FZ Ori) and the last 39,000 orbits (AH Tau) given by Nelson (2004). Qian and Ma (2001) suggest a parabolic ephemeris for FZ Ori based on the previous suggestion of El-Bassuny Alawy (1993). We have examined the O-C diagram (Qian and Ma 2001) for FZ Ori. Many of the minima given were determined visually or photographically, giving a large scatter. We do not find the argument for a nonlinear ephemeris compelling. The Heliocentric Julian Day of the primary minima can be computed by the following formula.

FZ Ori

$$\text{HJD Tmin I} = 2452950.09329 \ + 0.399984 \text{ d} \times \text{E}. \tag{1}$$

AH Tau

$$\text{HJD Tmin I} = 2451824.00832 \ + 0.33267174 \text{ d} \times \text{E}. \tag{2}$$

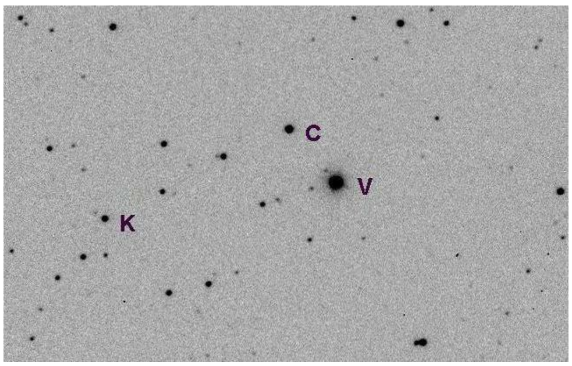

Figure 1. Finder Chart FZ Ori

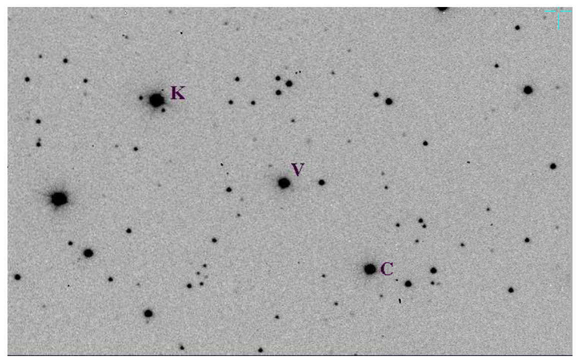

Figure 2. Finder Chart AH Tau

Table 1. Times of Minimum Light

Star	JD Hel. 2450000+	Min	O−C (days)
FZ Ori	2994.6868	II	-0.0048
FZ Ori	2995.6863	I	-0.0051
FZ Ori	2995.8865	II	-0.0050
AH Tau	2997.6735	I	-0.0007
AH Tau	3004.8272	II	0.0005
AH Tau	3005.6595	I	0.0012

We have calculated models for the light curves of both stars using the Wilson-Devinney code (Wilson 1993, henceforth WD). Common parameters that were varied include inclination of the orbit (i), temperature of the secondary star (T_2), modified potential of the stars ($\Omega_1 = \Omega_2$), mass ratio (q), relative luminosity of the primary star (L_1), and monochromatic linear limb darkening coefficient of the primary star ($x_1 = x_2$). Both stars were assumed to be contact binary systems (Mode 3). The values of gravity brightening and bolometric albedo were set at their suggested values for convective atmospheres (Lucy 1968), i.e., $G_1 = G_2 = 0.32$, $A_1 = A_2 = 0.5$. Synchronous rotation was assumed for each star ($F_1 = F_2 = 1.0$). Linear limb darkening coefficients were initialized at the model atmosphere values of Carbon and Gingerich (1969). The model atmosphere option was employed for each star.

A previous WD solution for FZ Ori has been published (Rukmini, et al. 2001). We used their value of T_1 and did not vary it. The two solutions compared very well, except in the value of the mass ratio (0.92 compared to our 0.792). Their value was based upon numerical experiments in which q was varied within a range. Their data have considerable scatter and we find evidence of a star spot. We ran the stellar spot model for FZ Ori and found that the presence of a hot spot on the primary star resulted in an accurate fit of the observed light curve. Table 2 presents our WD solution including the spot parameters.

AH Tau also has a previous WD solution (Liu, *et al.* 1991). We fixed the value of T_1 using a combination of the solution of Liu, et al. (1991) and the spectral type given by Bookmyer (1971) in conjunction with the calculations of Schmidt-Kaler (1982). Differences occur between our solutions in the values of L_1 (0.657 compared to our 0.574), q (0.503 compared to our 0.773), and i ($84.^{\circ}3$ compared to our $80.^{\circ}7$). Differences in the mass ratio also results in a difference in the modified potentials. The larger inclination in their solution produced larger stars to account for the depth and duration of the eclipses. Solution space for contact systems is filled with local minima, making accurate solutions difficult to obtain. The solutions presented here come from careful examination of the matrix of correlation coefficients and the use of the method of multiple subsets (Wilson and Biermann 1976). Both of these solutions for AH Tau call for component stars which are virtually identical and very close to solar values. It is difficult to see how two stars so nearly identical in their properties could be different by a factor of two in their masses. We also note that our mass ratio falls in a gap in the mass ratio grid of Liu, *et al.* Our WD solution for AH Tau is presented in Table 3.

The errors listed in Tables 2 and 3 are the formal errors of the partial differential least squares technique employed in the WD method. The values of the errors are used as a guide in determining the number of decimal places each parameter is given. We should note that the actual errors of the parameter determination may be higher.

Table 2. Wilson-Devinney Solution for **FZ Ori**

Wavelength Independent Parameters - Mode3

i	T_1	T_2	Ω_1	Ω_2	q	F_1	F_2	G_1	G_2	A_1	A_2
66.88	6108 K	6043 K	3.334	3.334	0.792	1.00	1.00	0.32	0.32	0.5	0.5
±0.12		±11	±0.007		±0.004						

Wavelength Dependent Parameters

Band	L_1	L_2	x_1	x_2
Vis	0.562	0.438	0.61	0.61
	±0.001		±0.05	
Red	0.561	0.439	0.60	0.60
	±0.001		±0.05	
IR	0.560	0.440	0.59	0.59
	±0.001		±0.04	

Spot Parameters

Co-Latitude	Longitude	Size	Temperature Factor
1.8 rad	6.1 rad	0.27 rad	1.17
±0.7	±0.5	±0.11	±0.06

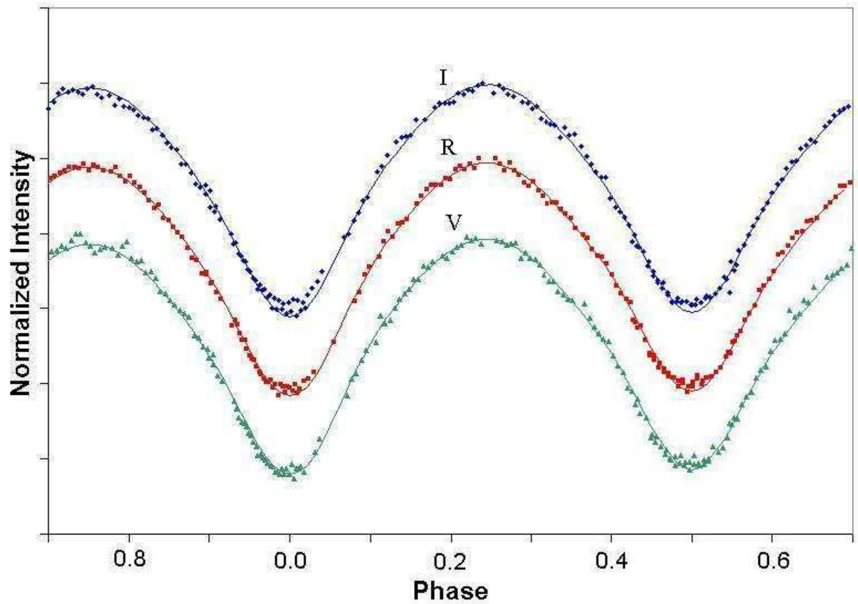

Figure 3. Light curves for FZ Ori

Solid curves are the Wilson-Devinney solution given below

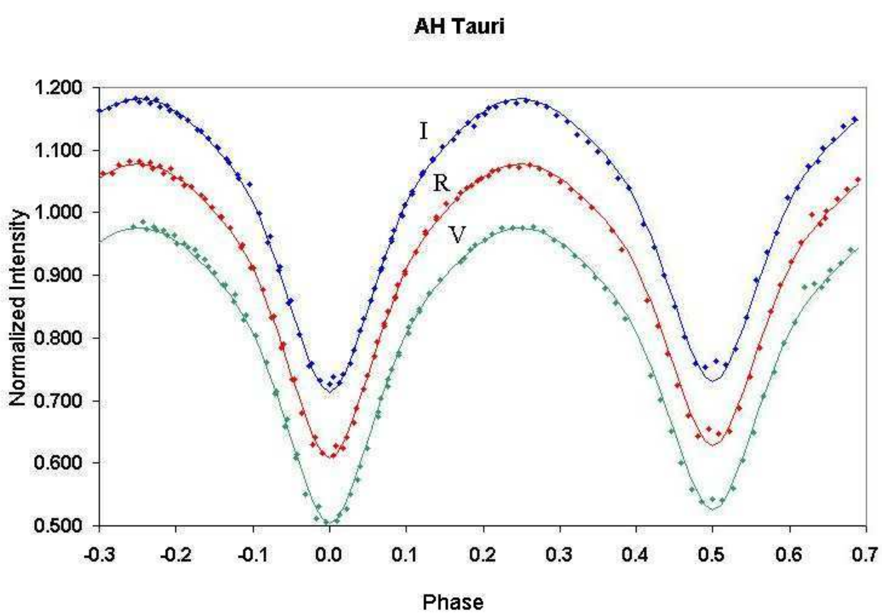

Figure 4. Light curves for AH Tau

Solid curves are the Wilson-Devinney solution given below

Table 3. Wilson-Devinney Solution for **AH Tau**

Wavelength Independent Parameters - Mode3

i	T_1	T_2	Ω_1	Ω_2	q	F_1	F_2	G_1	G_2	A_1	A_2
80.73	5900 K	5815 K	3.330	3.330	0.773	1.00	1.00	0.32	0.32	0.5	0.5
±0.12		±11	±0.009		±0.004						

Wavelength Dependent Parameters

Band	L_1	L_2	x_1	x_2
Vis	0.574	0.426	0.60	0.60
	±0.001		±0.07	
Red	0.571	0.429	0.60	0.60
	±0.001		±0.06	
IR	0.569	0.431	0.60	0.60
	±0.001		±0.06	

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HH Nor: A DOUBLE STAR WITH TWO VARIABLE COMPONENTS

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In a recent paper Dvorak (2004) listed several misidentified and missing southern eclipsing binaries. He compared ASAS-3 observations (Pojmanski 2002) with the available information in the GCVS catalogue (Kholopov et al. 2003) and checked their consistency. One of the "incorrectly classified variable stars" was HH Nor, listed as an Algol-type eclipsing binary in the GCVS (period: 8.58313 d). Contrary to this, Dvorak (2004) reclassified the star as an RR Lyrae type variable and determined a period of 0.598275 days. The wild disagreement with the GCVS and the apparent scatter of the phased ASAS-3 data in Dvorak (2004) caught our attention and this note summarizes our findings.

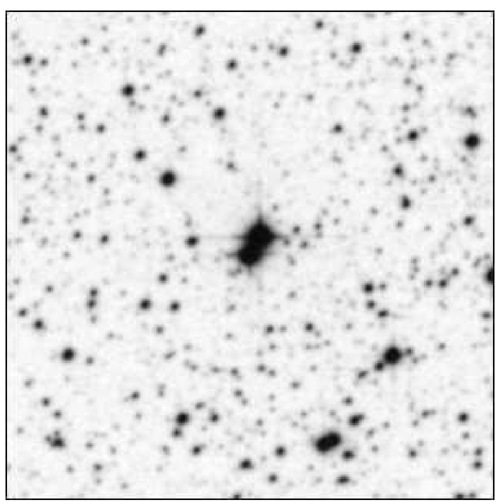

Figure 1. A $5' \times 5'$ DSS field centered on HH Nor. North is up, east is to the left.

The DSS image (Fig. 1) shows that the star is actually a visual double star of two comparable components. The first (and to our knowledge, the only) period determination was made by Alden (1935), who was fully aware of the double nature of the eclipsing binary named later as HH Nor. He referred to it as the fainter component of h 4794, a

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double star with similar components ($\Delta m \approx 1$ mag) separated by 12.″6 in position angle 148°. The same parameters are also listed in the CCDM catalogue (Dommanget & Nys 2002), which also gives the proper motions of the components. Since their separation is smaller than the confusion radius of the ASAS observations (about 20 arcsec, Pojmanski 2002), the system remained unresolved, so that the measured magnitudes contain light from both components. Therefore, our first conclusion is that the brighter component of the system is a newly discovered RR Lyrae type variable that outshone the eclipsing component (=HH Nor) in the blended images. However, the predominantly downward scatter in Fig. 2 of Dvorak (2004) shows that besides the RR Lyrae variations there is also information on HH Nor itself.

To extract this further information, we downloaded V-band ASAS-3 observations (`http://archive.princeton.edu/~asas/`) and performed a secondary light removal in two steps. We adopted $V = 10.3$ mag for the outside-eclipse brightness of HH Nor (as given by Alden 1935); after converting all magnitude values to fluxes, we subtracted HH Nor's light from the measured brightnesses and converted the results back to magnitudes. The remaining outlying points (mostly caused by the eclipses) were removed manually from the phased data, using the RR Lyr ephemeris in Dvorak (2004). This way we arrived to the corrected mean light curve of the RR Lyr component (left panel in Fig. 2).

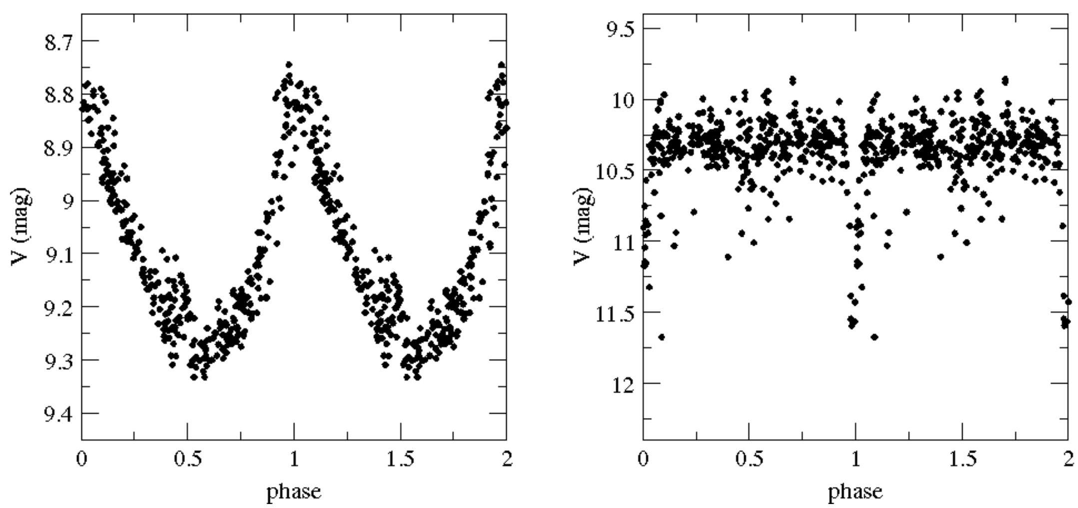

Figure 2. Corrected phase diagrams of the RR Lyrae component (left) and HH Nor (right).

In the next step we fitted this mean light curve with a third-order Fourier-polynomial, with which we corrected the initial data for the variations of the brighter star. The residuals were then analysed by a combination of the Phase Dispersion Minimization (Stellingwerf 1978) and the String Length method (Lafler & Kinman 1965). As a result, we derived a period of 8.5835(2) days, which is in very good agreement with that of by Alden (1935). The measured eclipse depth of the primary minimum (about 1.2 mag) is also in good agreement with the unblended observations of Alden (1935), which supports the consistency of the secondary light removal. We plot the final phase diagram of HH Nor in the right panel of Fig. 2. We summarize the main parameters for both variables in Table 1.

Finally, we have two concluding remarks. Firstly, Kiss & Bedding (2004) suggested in a recent work that blending calculations are highly advisable to be included into the regular

Table 1: Main parameters of "HH Nor" (=h 4794). E_0 is the epoch of minimum and maximum for the eclipsing and the pulsating component, respectively.

parameter	eclipsing component	RR Lyr component
RA(2000)[(a)]	15 43 30.17	15 43 29.37
Dec(2000)[(a)]	−51 50 48.9	−51 50 37.5
μ(RA) (mas/yr)[(a)]	2	−3
μ(Dec) (mas/yr)[(a)]	−23	−14
V (mag)[(b)]	10.3–11.5	8.8–9.3
period (d)	8.5835(2)[(b)]	0.598275[(c)]
E_0 (−2400000)	52503.348[(b)]	52093.53[(c)]

Data sources:[(a)] the CCDM catalogue; [(b)] this paper; [(c)] Dvorak (2004).

reduction procedure when working with large confusion radii. Here we wish to emphasize again this proposal: a cross-correlation with existing full-sky star catalogues with much smaller confusion radii (e.g. the USNO B1.0, Monet et al. 2003) would be necessary to add blending information in all cases when finally reduced data are made accessible to the wider community. If this star had been flagged as a possible blend, a misleading re-classification could have been avoided. And secondly, one shall always check the original references listed in the GCVS before concluding that there might be a misclassification. Although the NASA ADS Abstract Service is being constantly improved, early literature is rarely processed for linking objects via the SIMBAD database, so that one can easily miss the discovery papers or early analyses. To avoid this, the GCVS reference lists provide an important source of information.

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UBVRI OBSERVATIONS OF V350 Cep IN THE PERIOD 2002-2004

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The pre-main sequence (PMS) star V350 Cep lies in the region of active star formation NGC 7129. The historical light curve of V350 Cep resembles the FU Orionis (FUOR) type stars (Semkov et al. 1999) but its spectrum is similar to the Classical T Tauri stars (Magakian et al. 1999). Since 1970 a gradual increasing of star brightness has begun and the R magnitude of V350 Cep increased with $\sim 5^{\rm m}$ until 1977. Since 1977 the stellar brightness varies around the maximal value with an amplitude of about $1\overset{\rm m}{.}5$ (B).

The present data are a continuation of our investigation of V350 Cep (Semkov 1993; Semkov 1996; Semkov et al. 1999; Semkov 2002). Our photometric data were performed in two observatories with three telescopes: the 2-m Ritchey-Cretien-Coude and 50/70/172 cm Schmidt telescopes of the National Astronomical Observatory Rozhen (Bulgaria) and the 1.3-m Ritchey-Cretien telescope of the Skinakas Observatory[1] of the Institute of Astronomy, University of Crete (Greece). All frames ware taken through a standard Johnson-Cousins set of filters. The technical parameters for the CCD cameras used, observational procedure and data reduction process are described in Semkov (2002). As a reference the $UBVRI$ comparison sequence reported in Semkov (2002) was used. The results of our photometric observations of V350 Cep are summarized in Table 1. The table contains the date of observation, the Julian Date, the V magnitude, $U-B$, $B-V$, $V-R$ and $V-I$ indices and the used telescope.

Herbst et al. (1994) defined three basic types of brightness variation concerning PMS stars. Type I of variability is typical for Weak line T Tauri Stars (WTTSs). The variability is due to rotation of large cool surface spots. Periods of variability on time scales of days and amplitudes up to $0\overset{\rm m}{.}8$ in V are observed in WTTSs. Type II of variability occurs predominantly on Classical T Tauri Stars (CTTS) and it is caused by superposition of cool and hot surface spots. Non-periodic variations with amplitudes up to $3^{\rm m}$ in V are often observed on CTTSs. Type III is a more complicated variability observed on Herbig Ae/Be stars (HAEBESs) and some early F-G type CTTSs. The brightness variations are supposed to be produced by obscuration from circumstellar dust. The variability is either irregular or periodic on time scales of days or weeks and the observed amplitudes exceed up to $2\overset{\rm m}{.}8$ in extreme cases.

[1]Skinakas Observatory is a collaborative project of the University of Crete, the Foundation for Research and Technology - Hellas, and the Max-Planck-Institut für extraterrestrische Physik.

Table 1. Photometric observations of V350 Cep in the period February 2002 - May 2004

Date	J.D.(24...)	V	$U-B$	$B-V$	$V-R_C$	$V-I_C$	Tel.
5.02.2002	52311.226	16.08	–	0.97	0.84	2.04	Scm
6.02.2002	52312.219	16.22	–	–	0.92	2.12	Scm
7.02.2002	52313.213	16.09	–	1.18	0.82	2.04	Scm
8.06.2002	52433.502	16.344	–	1.054	1.012	2.160	1.3m
24.06.2002	52449.552	16.168	–	1.014	–	2.060	1.3m
2.07.2002	52457.533	16.105	−0.31	1.040	0.914	–	1.3m
3.07.2002	52458.546	16.193	–	1.015	0.962	2.076	1.3m
15.07.2002	52471.496	16.093	–	1.103	–	2.016	1.3m
22.08.2002	52508.543	16.199	–	1.071	0.953	2.055	1.3m
23.08.2002	52509.557	16.321	–	1.037	–	2.137	1.3m
24.08.2002	52510.549	16.374	–	–	–	2.150	1.3m
25.08.2002	52511.562	16.315	−0.15	0.978	0.985	2.134	1.3m
3.10.2002	52551.424	16.25	–	1.19	1.07	2.14	Scm
4.10.2002	52552.435	16.25	–	1.20	0.92	2.14	Scm
5.10.2002	52553.448	16.16	–	–	0.86	2.07	Scm
29.10.2002	52577.376	16.14	–	1.05	0.91	2.06	Scm
30.10.2002	52578.327	16.05	−0.36	1.00	0.89	1.98	Scm
31.10.2002	52579.214	16.07	−0.38	1.04	0.94	2.02	Scm
1.11.2002	52580.230	16.10	–	1.04	0.89	2.05	Scm
26.11.2002	52605.196	16.19	–	–	0.81	2.06	Scm
28.11.2002	52607.258	16.46	−0.45	1.10	1.01	2.27	Scm
29.11.2002	52608.220	16.38	–	1.23	0.97	2.22	Scm
28.02.2003	52698.592	16.391	−0.29	1.047	1.069	2.101	2m
2.03.2003	52700.581	16.398	−0.42	1.072	1.069	2.084	2m
3.03.2003	52701.568	16.247	−0.27	1.060	1.018	1.982	2m
3.04.2003	52732.587	16.32	–	1.04	0.97	2.17	Scm
1.05.2003	52761.461	16.29	–	–	0.97	2.15	Scm
2.05.2003	52762.440	16.24	–	1.01	0.90	2.14	Scm
5.05.2003	52765.448	16.21	–	0.93	0.96	2.11	Scm
11.06.2003	52801.544	16.273	–	–	–	2.136	1.3m
12.06.2003	52802.565	16.301	−0.34	1.039	–	2.136	1.3m
15.06.2003	52805.578	16.224	–	–	–	2.110	1.3m
16.06.2003	52806.570	16.108	–	1.006	–	2.057	1.3m
17.06.2003	52807.570	16.088	–	1.022	–	2.014	1.3m
18.06.2003	52808.569	16.221	–	1.043	–	2.028	1.3m
19.06.2003	52809.566	16.269	−0.24	1.069	–	2.080	1.3m
21.06.2003	52812.465	16.127	–	–	–	2.048	1.3m
23.06.2003	52813.573	16.173	–	–	–	2.077	1.3m
24.06.2003	52814.553	16.235	–	–	0.990	2.125	1.3m
25.06.2003	52815.563	16.326	–	–	0.993	2.171	1.3m
26.06.2003	52816.576	16.241	–	–	–	2.123	1.3m
27.06.2003	52817.561	16.111	–	–	–	–	1.3m
10.07.2003	52831.386	16.149	–	1.071	–	2.075	1.3m
12.07.2003	52832.565	16.134	–	1.040	–	2.057	1.3m
12.07.2003	52833.408	16.129	–	1.025	–	2.054	1.3m
13.07.2003	52834.424	16.044	–	1.031	–	2.026	1.3m
25.07.2003	52845.547	16.151	–	1.030	–	2.088	1.3m
26.07.2003	52846.581	16.065	–	1.021	–	2.070	1.3m
30.07.2003	52850.575	15.889	–	1.001	0.887	1.926	1.3m
9.08.2003	52860.539	15.990	–	–	–	1.981	1.3m
9.08.2003	52861.355	16.148	–	1.048	–	2.090	1.3m
10.08.2003	52862.416	16.179	–	1.076	–	2.101	1.3m
27.09.2003	52910.283	16.21	–	1.01	0.93	2.18	Scm
28.09.2003	52911.263	16.38	–	–	–	2.24	Scm
29.09.2003	52912.249	16.28	–	1.16	0.93	2.19	Scm
1.10.2003	52914.480	16.27	–	1.12	1.00	2.22	Scm
2.10.2003	52915.321	16.28	–	1.03	0.99	2.24	Scm
3.10.2003	52916.285	16.16	−0.25	1.04	0.97	2.16	Scm

Table 1. (continuation)

Date	J.D.(24...)	V	$U-B$	$B-V$	$V-R_C$	$V-I_C$	Tel.
24.10.2003	52968.410	15.88	–	–	–	1.96	2m
25.11.2003	52969.241	15.94	–	0.95	0.91	2.01	Scm
19.12.2003	52993.185	15.83	–	0.97	0.95	1.97	Scm
10.02.2003	53046.210	15.70	–	–	0.84	1.88	Scm
20.03.2003	53084.553	15.770	–	–	0.863	1.908	2m
21.03.2003	53085.578	15.963	–	–	0.923	2.046	2m
22.03.2003	53086.522	15.884	–	–	0.884	1.932	2m
13.05.2003	53138.513	15.97	–	0.99	0.90	2.03	Scm
13.06.2004	53170.440	15.87	–	–	0.91	1.96	Scm
15.07.2004	53201.407	15.89	–	–	0.85	1.98	Scm
16.07.2004	53202.433	16.03	–	1.05	0.93	2.05	Scm

The V-light curve of V350 Cep from all our CCD observations (Semkov 1996; Semkov et al. 1999; Semkov 2002 and this paper) is shown in Fig. 1. It is seen from the figure that for the ten years period of observations the star shows a long-term brightness variations on a time-scale of about one thousand days. Such long-term variability is also seen and from our photographic observations made in the period 1985-1994 (Semkov 1993; Semkov 1996). The long-term brightness variations are typical of HAEBE stars or related objects called UXors (Herbst and Shevchenko, 1999). The cause of variability of UXors can be obscuration from orbiting circumstellar matter or variable accretion from a circumstellar disk. In contrast to HAEBE stars and UXors V350 Cep is a low-mass star of M2 spectral type. The observed amplitude in V-light in the period 1994-2004 is only $0^{\mathrm{m}}_{\cdot}8$.

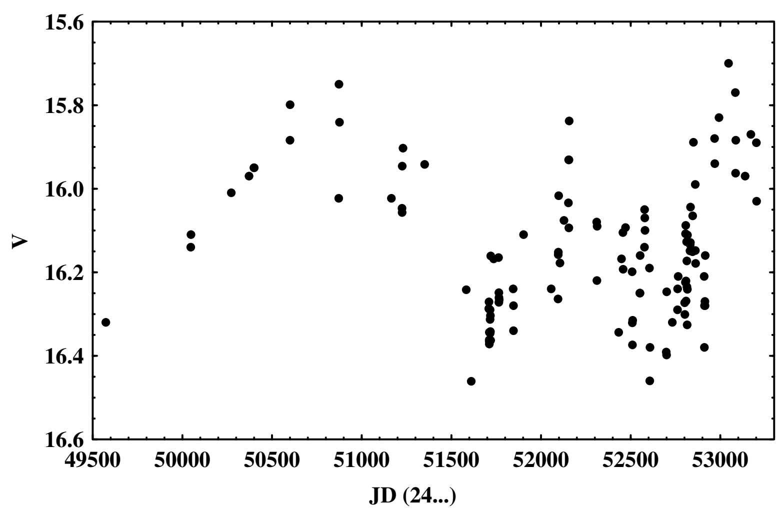

Figure 1. V-light curve of V350 Cep in the period August 1994 - July 2004

Another important result from our photometric study is the variation of color indices with stellar brightness. The measured color indices $V-I$ and $B-V$ versus stellar magnitude V during the period of our CCD observations are plotted in Fig. 2 and Fig. 3 respectively. A clear dependence can be seen from the figures: the star becomes redder as it fades. Such color variations are typical of stars with large cool spots whose variability is produced by rotation of the spotted surface (WTTs). Consequently, V350 Cep shows photometric characteristics of FUORs (5 magnitudes outburst), UXors (long-term brightness variations) and WTTs (variability with small amplitude in time scale of days). On the other hand, the observed spectra of V350 Cep can be classified as a CTTs spectrum (Magakian et al. 1999). As is seen from Table 1 V350 Cep shows a very strong ultraviolet excess a characteristic also typical of CTTs. These discrepancies make V350 Cep a unique object very difficult for exact classification.

The author thanks the Director of Skinakas Observatory Prof. I. Papamastorakis and Dr. I. Papadakis for the telescope time.

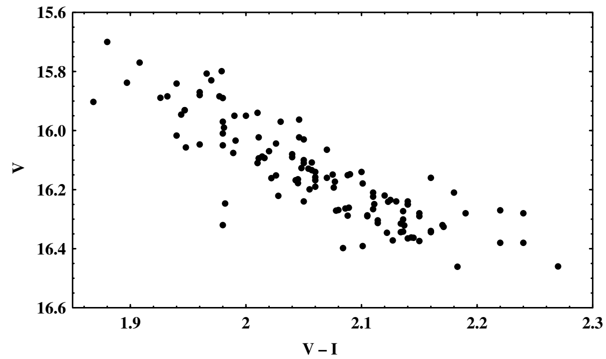

Figure 2. Relationship between V magnitude and V-I color index in the period of observations

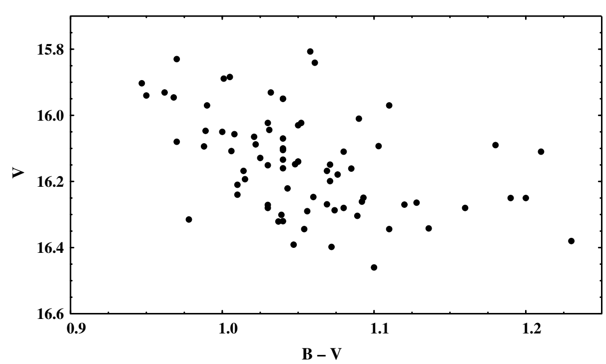

Figure 3. Relationship between V magnitude and B-V color index in the period of observations

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NEW ELEMENTS FOR 80 ECLIPSING BINARIES IV.

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The ASAS-3 (Pojmanski, 2002) and Hipparcos (Perryman et al., 1997) databases have been used as in the previous lists (Otero, 2003) to find new elements for 80 eclipsing binaries. Starting with this paper, the NSVS (Northern Sky Variability Survey) database (Wozniak et al., 2004) has also been used. The NSVS observations were collected by the ROTSE-1 experiment using a robotic system of four unfiltered telephoto lenses equipped with CCD cameras. The spectral response ranges from 450 to 1000 nm covering from mid-B to mid-I Johnson-Cousins photometric passbands. Magnitudes were calibrated against 500-1000 Tycho stars per frame. NSVS data have been combined with ASAS-3 and Hipparcos data to improve the period determinations and a systematic offset of all the ROTSE-1 magnitudes to the V magnitude of the stars has been applied. No amplitude difference has been found in any case so the ranges given are V-band magnitudes. For stars more northern than +28° declination, when neither ASAS nor Hipparcos magnitudes were available, observations from the TASS (Droege, 2003) database have been used in combination with NSVS data. In these cases, extreme care was taken in order to avoid error dates or problems that can arise from the use of this experimental dataset (Droege, 2004). Light curves were cleaned of the dubious observations therein that showed clear deviation from the mean magnitude in the folded light curves, prior to deriving the final elements. Saturated data in ASAS-3 and flagged observations in the Hipparcos Epoch Photometry and the NSVS dataset were also discarded. Hipparcos observations have been transformed to V using a table by the author published electronically in IBVS No. 5482 (Otero, 2003b). The candidate stars were selected from the Hipparcos Variability Annex and the NSV catalogue (Kukarkin and Kholopov, 1982) and its supplement (NSVS) (Kazarovets et al., 1998). Stars classified as eclipsing binaries and those showing mean Hp magnitudes close to the maximum Hp values in the Hipparcos Variability Annex were identified and their ASAS-3 and/or NSVS data subsequently obtained. Stars classified as possible eclipsing systems (of all types) and those with a spectral type between O and G that had no given classification within the NSV catalogues were also checked. The method of bisected chords was used to determine times of minima. The accuracy depends on the quantity and quality of the observations. Elements were found with AVE (Barberá, 1999) and a Microsoft Excel period search utility kindly provided by Patrick Wils (Wils, 2003). Table 1 shows the list of variables. The first column gives the variable star designation according to the GCVS. The following columns give another identifier;

the brightness range of the variable, with the magnitude of secondary eclipse between brackets; the epoch of minimum light derived from the complete dataset; the period; the variability class and the spectral type with a note to the spectral type source.

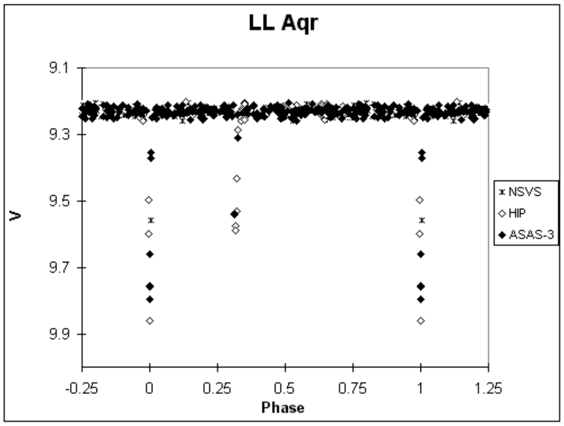

Figure 1. Light curve of LL Aqr showing ASAS-3, Hipparcos and NSVS observations.

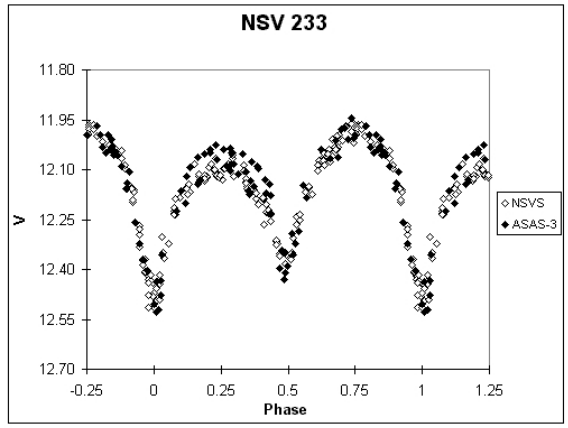

Figure 2. Light curve of NSV 00233 showing ASAS-3 and NSVS observations.

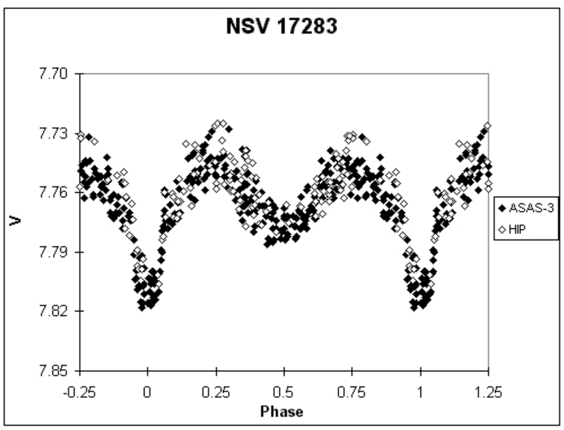

Figure 3. Light curve of NSV 17283 showing ASAS-3 and Hipparcos observations.

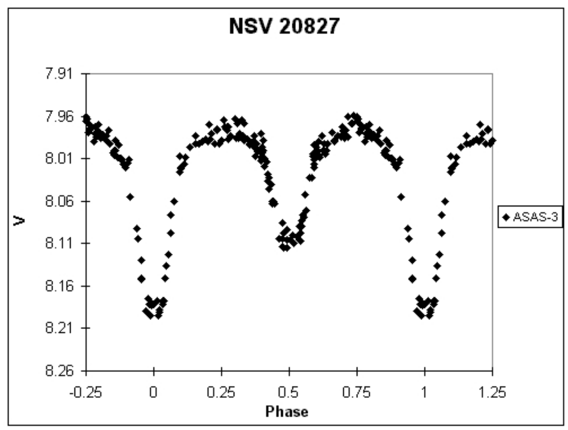

Figure 4. Light curve of NSV 20827 showing ASAS-3 observations.

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Table 1. New elements for 80 eclipsing binary stars.

Star Name		Magnitude range	Epoch	Period	Type	Spectral type
Variable	Other ID	(V)	(HJD2440000+)	(days)		
AC Pyx *	HIP 041811	7.78 – 8.06 (8.03)	8503.246	7.66793	EA	A0/A1IV (4)
DP Cet *	HIP 010099	6.79 – 6.99 (6.9:)	8686.729	2.36817	EA	A2 (24)
DV Boo *	HIP 070287	7.53 – 7.76 (7.69)	8045.254	3.78264	EA	F1Vm (8)
GZ Dra *	HIP 089243	9.46 – 9.78 (9.6:)	8745.844	2.253355	EA	F0 (24)
GZ UMa	HIP 052892	10.48– 11.02(10.98)	11556.830	6.5420	EA	G0 (28)
IL Lib *	HIP 074127	7.56 – 7.84(7.81:)	8443.842	5.76937	EA	F0V (5)
IV Lib *	HIP 076480	8.35 – 8.95 (8.55)	11932.900	6.8617	EA/GS	K1III+(F) (4)
IW CMa	HIP 030583	6.88 – 7.02 (6.99)	8799.850	6.23584	EA	A0V (3)
KV CMa *	HIP 032856	7.16 – 7.40(7.40:)	8353.430	68.3842	EA	B3n (44)
LL Aqr *	HIP 111454	9.23 – 9.86 (9.59)	8762.552	20.1784	EA	G1V (5)
LQ Mus *	HIP 062801	9.04 – 9.66:(9.65)	12712.719	7.50640	EA	F5V (1)
MP Del *	HIP 100981	7.56 – 7.87 (7.81:)	8246.300	21.3387	EA	A3mA8-F3 (27)
NSV 00233*	GSC 0013 0919	11.97– 12.52(12.41)	11384.436	4.09242	EB	
NSV 00726	GSC 2317 0163	11.90– 12.5:(12.05)	11437.733	0.88198	EB:	
NSV 01403	GSC 4327 0280	12.30– 14.4 (12.47)	11401.892	1.40856	EA	
NSV 02470	GSC 0714 0391	11.95– 13.32 (12.3)	12896.886	5.5416	EA	
NSV 03443	GSC 9380 1419	12.45– 14.6 (12.65)	11935.585	4.5521	EA	
NSV 03728	GSC 0790 0482	11.32–11.95(11.83:)	12971.806	2.14948	EA	
NSV 04638	GSC 4631 1042	10.57– 10.95(10.85)	11278.439	0.690046	EB	F4(14)
NSV 05040	GSC 3827 0163	12.68– 13.4 (13.4:)	11306.810	3.02405	EA	
NSV 05914	GSC 6110 0930	12.76– 14.7(13.05:)	12086.498	1.78878	EA	
NSV 06157*	HIP 064716	8.77 – 8.98 (8.87)	11955.858	13.4197	EA	B1/2V (1)
NSV 06968	GSC 7830 0775	12.15– 14.2:(12.32)	12441.566	5.4193	EA	
NSV 07178*	HD 139337	9.20 – 9.56 (9.51)	12062.557	3.2300	EA	B9IV (1)
NSV 07400*	HD 143511	8.33 – 8.88 (8.85)	12104.552	5.5354	EA	A0IV/V (1)
NSV 07746	GSC 7348 1787	12.88– 14.2:(13.07)	12924.412	2.918	EA	
NSV 08499	GSC 4568 0313	11.09– 12.00(11.70)	11274.913	0.32540	EW	
NSV 10982*	GSC 5699 2009	9.69 – 9.96 (9.93)	12879.618	4.95232	EA/KE	B1:V:pe (36)
NSV 11243*	HD 172666	10.05–10.55:(10.27)	12104.605	6.4478	EA	A9IV (2)
NSV 11781*	HD 178755	8.60 – 9.05 (8.88:)	12474.633	11.7902	EA	B9V (3)
NSV 12326	GSC 8778 1496	12.76– 13.74(12.9:)	12069.712	0.844598	EA	
NSV 12870*	GSC 2679 2844	10.97– 11.27 (11.2)	11354.500	32.34	EB/GS:	
NSV 13121	GSC 0522 0799	12.25–12.45(12.93:)	12832.775	0.646147	EA	
NSV 13625*		13.4 – 14.1 (13.6)	11282.392	1.31477	EB	
NSV 15234*	HIP 004974	8.78 – 9.0: (8.92:)	12559.740	14.7104	EA	F5/6V (3)
NSV 15375*	HIP 008156	8.44 – 8.54(8.51:)	8648.639	1.69261	EA	F0 (24)
NSV 15730	HIP 017094	9.73 – 10.03(10.0:)	8678.948	3.76674	EA	A4IV (8)
NSV 16199*	HIP 022979	9.07 – 9.20(9.18:)	8181.925	1.528311	EA	A0 (24)
NSV 16296*	HIP 025174	7.08 – 7.14 (7.12)	8188.925	2.22878	EA	B9.5V (5)
NSV 17236*	HIP 033303	8.21 – 8.41 (8.41)	12232.752	0.372457	EW	F6/8+G6/8 (5)
NSV 17283*	HIP 033844	7.73 – 7.82 (7.78)	12942.804	3.37443	EB	A2V (3)
NSV 17436	HIP 035624	8.74 – 8.92 (8.78)	8536.929	1.04776	EA	A2 (24)
NSV 17456*	HIP 035859	7.98 – 8.11 (8.02)	7912.729	2.198515	EA	B9III (3)
NSV 17552	HIP 037455	8.12 – 8.33(8.30:)	8196.000	31.4204	EA	B9.5/A0IV (5)
NSV 17578*	HD 062589	8.11 – 8.35 (8.33)	12540.855	6.3177	EA	B3IVk (45)
NSV 17647*	HIP 038581	8.13 – 8.22 (8.20)	8588.418	7.72461	EA	A0V (5)
NSV 17723*	HIP 039390	9.04 – 9.16 (9.10)	7913.248	1.425902	EA	A0V (3)
NSV 18104*	HD 077207	9.37 – 9.48 (9.47)	12714.620	11.4248	EA	B0IVnp (17)
NSV 18480*	HIP 052362	9.04 – 9.22 (9.22)	8970.460	1.46857	EA	F2V (2)
NSV 18546*	HIP 053209	9.27 – 9.50(9.50:)	8058.296	5.50762	EA	G5IV (42)
NSV 18553*	HIP 053357	9.47 – 9.63 (9.60)	8603.597	2.354858	EA	A7III (24)
NSV 18786*	HIP 056249	7.88 – 7.96 (7.95)	8502.854	5.48793	EA	B9.5V (1)
NSV 19698*	HIP 063245	9.78 – 10.03(9.99:)	8557.320	7.1520	EA	A3 (24)
NSV 19703	GSC 8994 2160	10.44– 10.67(10.65)	11985.818	11.0385	EA	B3-B5 (46)
NSV 19773*	HIP 065380	9.42 – 9.59 (9.50)	8331.778	0.795629	EA	A1V (24)

Table 1. New elements for 80 eclipsing binary stars.

Star Name		Magnitude range	Epoch	Period	Type	Spectral type
Variable	Other ID	(V)	(HJD2440000+)	(days)		
NSV 20174*	HIP 072178	8.66 – 8.75 (8.75)	8347.805	7.06114	EA/DM	F3/F5V (2)
NSV 20433*	HIP 077972	8.67 – 9.06 (8.82)	13170.910	29.6924	EA	F5 (24)
NSV 20782	HIP 082378	7.96 – 8.07 (8.01)	8704.307	4.49244	EA	O9.5IV (39)
NSV 20827*	HD 152333	7.96 – 8.19 (8.11)	12439.649	2.15767	EA/KE	09.5IV (47)
NSV 20894*	HIP 083583	8.87 – 9.03(9.02:)	8005.710	29.3467	EA	B9IV/V (3)
NSV 20913*	HIP 083634	8.26 – 8.43 (8.36)	12787.824	10.8743	EA	A5 (33)
NSV 22984*	HIP 086058	9.04 – 9.15 (9.15)	8604.780	3.10886	EA	A0 (24)
NSV 24620*	HIP 092754	9.68 – 9.96(9.96:)	8017.991	1.21125	EA	G3V (2)
NSV 25862*	HIP 109743	9.09 – 9.25 (9.17)	11450.602	6.00911	EA	B8 (24)
NSV 25928*	HIP 111590	9.84 –10.04(10.02:)	8305.198	6.15727	EA	B9V (8)
PQ Vel *	HIP 044612	7.63 – 7.81(7.75:)	8256.740	22.2632	EA	A2/3III(m) (2)
PS Ser *	HIP 077045	8.08 – 8.37(8.16:)	8596.364	15.8861	EA/RS	F8+F8 (37)
QR Hya *	HIP 053487	8.39 – 8.70(8.45:)	8948.181	2.502939	EA	G1V (3)
QT Peg	HIP 112058	7.43 – 7.75 (7.46)	8645.097	3.5937	EA	A1V (27)
QY Vel *	HIP 048185	8.13 – 8.30 (8.19)	8753.850	46.390	EA/GS	G5III (2)
V0339 Gem	HIP 035428	8.86 – 9.37 (8.89)	8361.280	2.88032	EA	A3m (32)
V0365 Pup*	HIP 035447	7.82 – 8.60(8.06:)	8202.637	30.0338	EA/DM	A0V (3)
V0392 And*	HIP 116685	9.07 – 9.41 (9.41)	8035.107	4.046275	EA	A2 (24)
V0394 Vul	HIP 097500	8.70 – 8.98 (8.83)	8248.702	3.080315	EA	A3 (24)
V0454 Cep*	HIP 113065	9.04 – 9.30 (9.13)	8313.100	5.58450	EA	B1V (43)
V0467 Car*	HIP 040838	8.02 – 8.45 (8.09)	8692.080	7.04615	EA	B9IV (1)
V0775 Cas*	HIP 008693	9.73 – 10.26(10.07)	8766.027	5.39017	EA	B8V (38)
V0912 Her*	HIP 081967	8.59 – 8.73 (8.72)	8002.955	3.40985	EA	G5 (24)
V1044 Sco*	HIP 078708	8.60 – 9.07 (8.92)	13064.836	0.914833	EA	K0V (4)
V1126 Tau*	HIP 017040	10.37–10.54(10.53:)	8527.515	3.38751	EA	F8 (28)

Sources of spectral type: (1) Houk and Cowley, 1975. (2) Houk, 1978. (3) Houk, 1982. (4) Houk and Smith-Moore, 1988. (5) Houk and Swift, 1999. (8) Kennedy, 1983. (14) Kholopov et al., 2003. (17) Buscombe, 1998. (24) Ochsenbein, 1980. (27) Grenier et al., 1999. (28) Kharchenko, 2001. (32) Bartaya, 1987. (33) Cannon and Pickering, 1993. (36) Jaschek et al., 1964. (37) Batten et al., 1989. (38) Boulon and Fehrenbach, 1958. (39) Schild et al., 1969. (42) Glebocki et al., 2000. (43) Hardorp et al., 1959-1965. (44) Rubin et al., 1962. (45) Skiff, 2003. (46) Sundman et al., 1974. (47) Jaschek, 1978.

Notes on individual stars:

AC Pyx = Eccentric system. Visual binary. $A=8\overset{m}{.}0$; $B=10\overset{m}{.}0$ Hp. Sep. $1\overset{m}{.}91$ (Perryman et al., 1997).
DP Cet = Slightly eccentric. Wrong period in the HIP catalogue ($3\overset{d}{.}1748$).
DV Boo = Wrong period of $1\overset{d}{.}26086$ in the HIP catalogue.
GZ Dra = Visual binary. $A=9\overset{m}{.}9$; $B=10\overset{m}{.}9$ Hp. Sep. $0\overset{''}{.}43$ (Perryman et al., 1997).
IL Lib = Primary eclipse might be the secondary.
IV Lib = Wrong period in the HIP catalogue ($6\overset{d}{.}3605$). Changing O'Connell effect. Visual binary. $B=11\overset{m}{.}8$. Sep. $4\overset{''}{.}2$ (Dommanget et Nys, 2002).
KV CMa = Eccentric system. Primary eclipse might be the secondary. Period found with help of visual observations by the author.
LL Aqr = Eccentric system.
LQ Mus = Wrong period in the HIP catalogue ($4\overset{d}{.}0070$). Primary eclipse might be the secondary.
MP Del = Eccentric system.
NSV 00233 = Strong and variable O'Connell effect. Max. II $V=12\overset{d}{.}07$.
NSV 06157 = Eccentric system. Not classified as variable in the HIP catalogue although there were 3 secondary eclipses recorded.
NSV 07178 = Eccentric system.
NSV 07400 = Eccentric system.
NSV 10982 = Classified as a GCAS star in the NSV catalogue (Kukarkin and Kholopov, 1982).
NSV 11243 = Slightly eccentric.
NSV 11781 = Eccentric system.
NSV 12870 = Classified as LB in the NSV catalogue (Kukarkin and Kholopov, 1982). Tycho-2 $B-V=0\overset{m}{.}82$ (Hog et al., 2000)

NSV 13625 = Inaccurate position in the GCVS. The star is USNO-A2.0 1275-15145487. UCAC2 (Zacharias et al., 2003) position is $21^{\rm h}15^{\rm m}37\overset{\rm s}{.}231$ $+38^\circ02'27\overset{''}{.}70$ (2000.0). ROTSE1 magnitudes, no data from TASS.
NSV 15234 = Eccentric system. Visual binary. A=$9\overset{\rm m}{.}5$; B=$9\overset{\rm m}{.}8$ Hp. Sep. $0\overset{''}{.}80$ (Perryman et al., 1997).
NSV 15375 = Visual binary. A=$9\overset{\rm m}{.}1$; B=$9\overset{\rm m}{.}8$. Sep. $0\overset{''}{.}2$ (Dommanget et Nys, 2002).
NSV 16199 = Visual binary. A=$10\overset{\rm m}{.}0$; B=$9\overset{\rm m}{.}8$ Hp. Sep. $0\overset{''}{.}86$ (Perryman et al., 1997).
NSV 16296 = Visual binary. A=$7\overset{\rm m}{.}72$; B=$7\overset{\rm m}{.}98$ V (Shatsky et al., 1999). Sep. $4\overset{''}{.}76$ (Perryman et al., 1997)
NSV 17236 = Period given is based only on ASAS-3 data. Possible period change, HIP observations are noisy due to duplicity but only fit at a period of $0\overset{\rm d}{.}372461$. Visual binary. A=$8\overset{\rm m}{.}6$v; B=$9\overset{\rm m}{.}84$ (Mermilliod et al., 1997). Combined brightness given. Sep. $13\overset{''}{.}9$ (Perryman et al., 1997).
NSV 17283 = Period $1\overset{\rm d}{.}6872$ in the HIP catalogue with no variability type.
NSV 17456 = Eccentric system.
NSV 17578 = Eccentric system. Visual binary. A=$8\overset{\rm m}{.}6$; B=$9\overset{\rm m}{.}1$ V. Sep. $0\overset{''}{.}2$ (Dommanget et Nys, 2002).
NSV 17647 = ASAS-3 V-magnitudes are 0.05 mag. fainter than Hipparcos V-magnitudes. ASAS mag. were adopted.
NSV 17723 = Visual binary. A=$9\overset{\rm m}{.}65$; B=$10\overset{\rm m}{.}0$ Hp. Sep. $8\overset{''}{.}59$ (Perryman et al., 1997).
NSV 18104 = Slightly eccentric.
NSV 18480 = Slightly eccentric system. Primary eclipse might be the secondary.
NSV 18546 = Period might be half the value given. Visual binary. A=$9\overset{\rm m}{.}6$; B=$11\overset{\rm m}{.}9$ Hp. Sep $1\overset{''}{.}12$ (Perryman et al., 1997).
NSV 18553 = Koen an Eyer (2002) give a wrong period of 0.5886647 d.
NSV 18786 = Eccentric system.
NSV 19698 = Slightly eccentric.
NSV 19773 = Koen and Eyer (2002) give per = 0.3977978 d.
NSV 20174 = Period might be half the value given. Primary eclipse might be the secondary.
NSV 20433 = Very eccentric system. Total eclipses.
NSV 20827 = Spectroscopic binary with a period of $2\overset{\rm d}{.}1579$ in Batten et al., 1989.
NSV 20894 = Period might be half the value given.
NSV 20913 = Eccentric system. Visual binary. A=$8\overset{\rm m}{.}6$; B=$10\overset{\rm m}{.}1$ Hp. Sep. $1\overset{''}{.}44$ (Perryman et al., 1997).
NSV 22984 = Primary eclipse might be the secondary.
NSV 24620 = Visual binary. A=$9\overset{\rm m}{.}9$; B=$13\overset{\rm m}{.}3$ Hp. Sep. $3\overset{''}{.}14$ (Perryman et al., 1997).
NSV 25862 = Visual binary. A=$9\overset{\rm m}{.}2$; B=$12\overset{\rm m}{.}7$ Hp. Sep $0\overset{''}{.}72$ (Perryman et al., 1997).
NSV 25928 = Period might be half the value given.
PQ Vel = Eccentric system. Period $22\overset{\rm d}{.}25$ in the HIP catalogue. Very few observations at minimum II.
PS Ser = RS period is $18\overset{\rm d}{.}843$ Koen and Eyer (2002) give per= $18\overset{\rm d}{.}769$ Known as a spectroscopic binary with a period of $15\overset{\rm d}{.}8880$ (Batten et al., 1989) Visual binary. A=$8\overset{\rm m}{.}7$; B=$9\overset{\rm m}{.}3$ Hp. Sep. $0\overset{''}{.}4$ (Perryman et al., 1997). B is also a spectroscopic binary. AB-combined light given. The F8+F8 spectrum is for the unresolved A and B stars.
QR Hya = Eccentric system.
QY Vel = Wrong period in the HIP catalogue ($9\overset{\rm d}{.}571$).
V0365 Pup = Eccentric system. Period $30\overset{\rm d}{.}01$ in the HIP catalogue.
V0392 And = Period might be half the value given. Primary eclipse might be the secondary. Visual binary. A=$9\overset{\rm m}{.}3$; B=$11\overset{\rm m}{.}5$ Hp. Sep. $2\overset{''}{.}28$ (Perryman et al., 1997). Hipparcos $B-V$ ($0\overset{\rm m}{.}14$) is wrong. $B-V$ from Tycho-2 is $0\overset{\rm m}{.}42$, consistent with TASS V magnitude.
V0454 Cep = Slight apsidal motion. Batten et al. (1989) give a spectroscopic period of $5\overset{\rm d}{.}6556$.
V0467 Car = Eccentric system.
V0775 Cas = Eccentric system. Wrong period suggested in the HIP catalogue ($2\overset{\rm d}{.}95946$).
V0912 Her = Primary eclipse might be the secondary.
V1044 Sco = Visual binary. A=$8\overset{\rm m}{.}8$; B=$11\overset{\rm m}{.}5$ Hp. Sep. $10\overset{''}{.}3$ (Perryman et al., 1997). Cutispoto et al. (1999) give spectral type G9V+M0:V+K7:V. According to Woolley et al. (1970), the M0 star is the visual binary.
V1126 Tau = Visual binary. A=$10\overset{\rm m}{.}7$; B=$12\overset{\rm m}{.}5$ Hp. Sep. $0\overset{''}{.}28$ (Perryman et al., 1997).

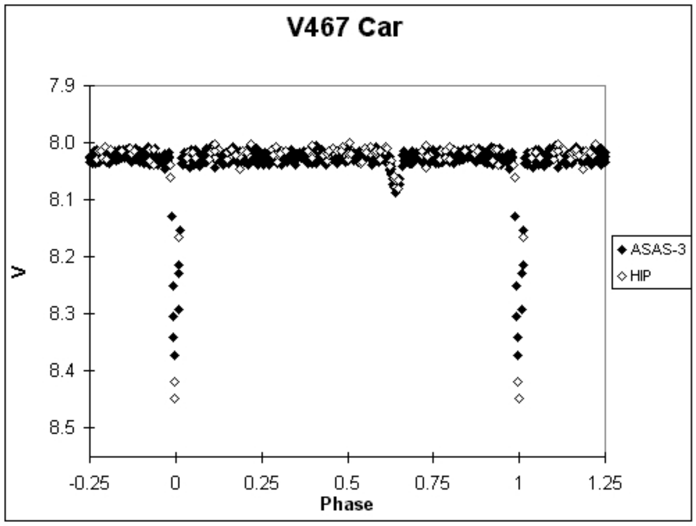

Figure 5. Light curve of V0467 Car showing ASAS-3 and Hipparcos observations.

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ERRATUM FOR IBVS 5557

Sebastian Otero reported the following error:

IBVS No.	item	printed	correct
5557	identifier (NSV 233)	GSC 0013-0919	GSC 0013-0976

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NEW VARIABLE STARS IN THE OPEN CLUSTER M35 (NGC 2168)

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Observatory and telescope:
Mt. Lemmon Optical Astronomy Observatory in USA, 1.0m telescope

Detector:	KODAK KAF-4301E 2048 CCD camera

Filter(s):	Johnson V

Transformed to a standard system:	yes
Standard stars (field) used:	Landolt (1992)'s SA 98

Availability of the data:
5558-t2.txt, 5558-t3.txt

Method of data reduction:
Standard CCD-frame reduction using the IRAF/DAOPHOT[1] package.

Table 1. Photometric parameters of observing stars from the WEBDA (Mermilliod, 1992)

ID_{WEBDA}	ID_{OUR}	RA (J2000)	DEC (J2000)	V	(B−V)	(V−I)
3053	V1	$06^h08^m13\overset{s}{.}22$	$+24°18'30\overset{''}{.}8$	$16\overset{m}{.}43$	$0\overset{m}{.}64$	$0\overset{m}{.}863$
3703	V2	$06^h09^m03\overset{s}{.}31$	$+24°23'15\overset{''}{.}6$	$17\overset{m}{.}10$	$1\overset{m}{.}30$	$1\overset{m}{.}395$
272	Comp	$06^h08^m37\overset{s}{.}36$	$+24°21'57\overset{''}{.}5$	$14\overset{m}{.}20$	$0\overset{m}{.}96$	$1\overset{m}{.}180$
241	Check	$06^h08^m44\overset{s}{.}30$	$+24°17'25\overset{''}{.}2$	$14\overset{m}{.}46$	$0\overset{m}{.}40$	$0\overset{m}{.}607$

Ephemeris:			
Star name	E 2400000+	P [day]	Source
V1	53071.755	0.0691	present paper
V2	53071.731	0.3639	″

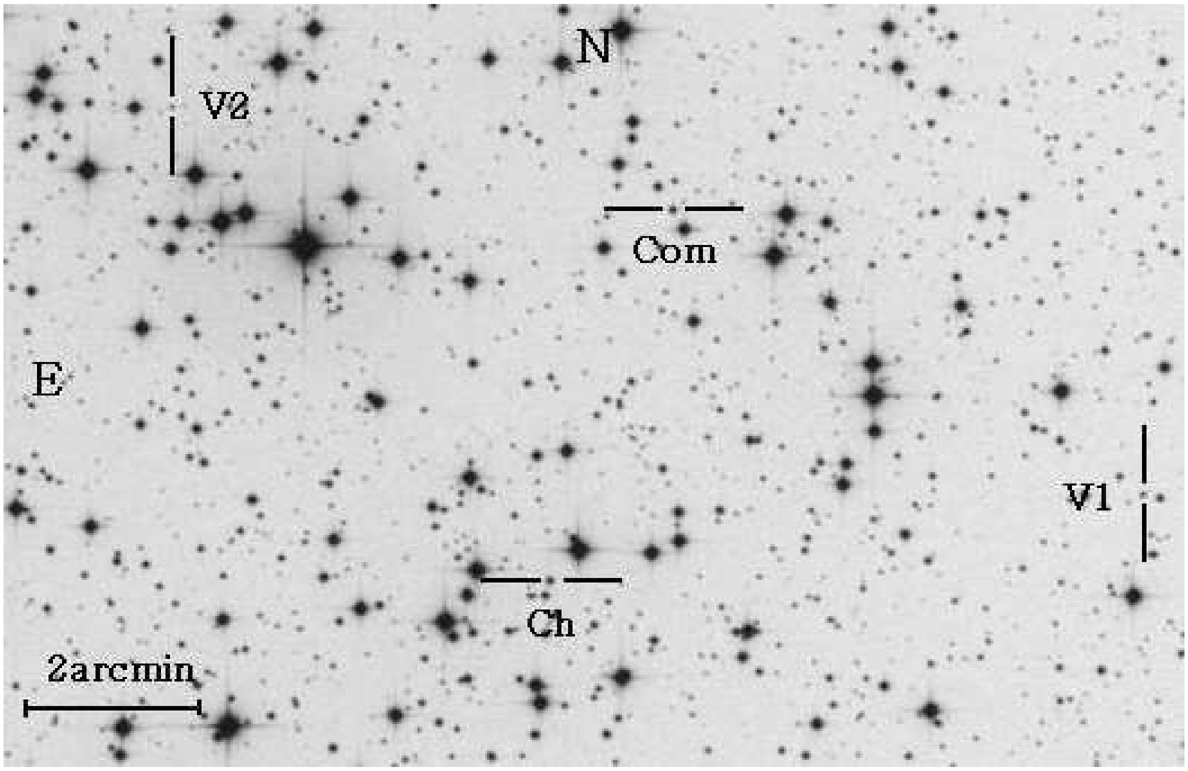

Figure 1. The finding chart of the new variable stars is presented in Fig. 1. New variables are labeled (V1) and (V2) . The field is (14.′0×9.′0), north is at the top and east to the left. The chart is retrieved from the STScI Digitized Sky Survey Second Generation Red.

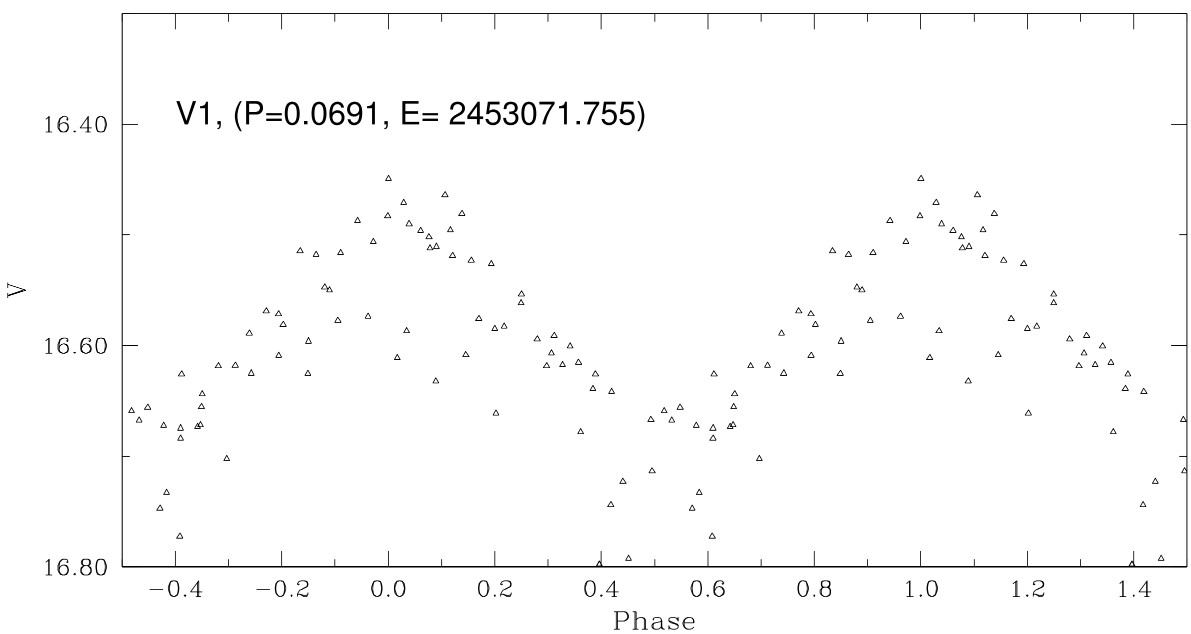

Figure 2. Phase diagram of V1

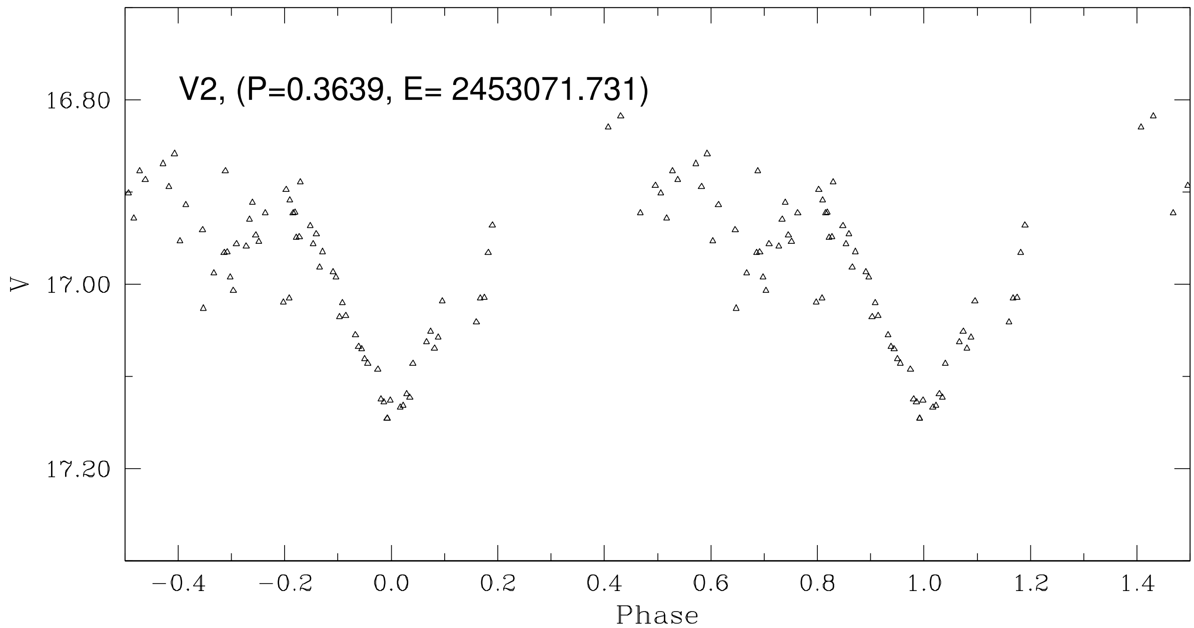

Figure 3. Phase diagram of V2

Remarks:
As a part of our survey project to searching for low-amplitude pulsating stars in open clusters, we carried out time-series CCD photometry for 2 nights March 7th to 8th 2004 in the open cluster M35 (NGC2168). The observations were performed with the 1.0m telescope at Mt. Lemmon Optical Astronomy Observatory (LOAO), Arizona, USA; Korea Astronomy Observatory has installed the telescope in September 2003. We examined light variation of 1128 stars in the observed field and found two variable stars. One is a δ Sct type star and the other is a suspected eclipsing binary. We applied the ensemble normalization technique (Gilliland & Brown 1988, Kim et al. 1999) to standardize the instrumental magnitudes of all stars in the time-series CCD frames (for UBVI photometry of M53 see Sung and Bessell 1999). Finding chart of these new pulsating stars is shown in Figure 1. Light curves are displayed in Figure 2 and Figure 3.

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[1]IRAF is distributed by the National Optical Astronomy Observatories, which are operated by the Association of Universities for Research in Astronomy, Inc., under cooperative agreement with the National Science Foundation.

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DISCOVERY OF CVS ROTSE3 J151453.6+020934.2 AND ROTSE3 J221519.8-003257.2

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The ROTSE-III telescope array is a worldwide network of 0.45 m robotic, automated telescopes, built for fast ($\sim$ 6 s) responses to Gamma-Ray Burst (GRB) triggers from satellites such as Swift. They have a wide 1.85 degree field of view imaged onto a Marconi 2048 $\times$ 2048 back-illuminated thinned CCD, and operate without filters, and we have a wide passband that peaks around 550 nm. The ROTSE-III systems are described in detail in (Akerlof et al. 2003). While not observing GRB triggers, the ROTSE-III systems engage in a search for short duration transients. High galactic latitude equatorial fields are scanned every night, with two pairs of images taken with a 30 minute cadence. Our search is optimized for finding transients lasting $\sim$1 hr above our limiting magnitude of 19, although we also detect longer transients including cataclysmic variables (CVs). In this bulletin we report on the discovery of two such CVs in 2004.

On 29 March, 2004, the ROTSE-IIIb telescope located at McDonald Observatory, Texas, detected a bright 16$^{\mathrm{th}}$ magnitude object, which we designate ROTSE3 J151453.6+020934.2 (hereafter J1514). Only 20 hours earlier, on 28 March, 2004, the ROTSE-IIIa telescope located at Siding Spring Observatory had imaged the same field, and had not detected an object to a limiting magnitude of 18.2. The ROTSE-III observations were processed by our standard pipeline. We measure aperture magnitudes using SExtractor (Bertin & Arnouts 1996), and then compare all the field stars to the USNO A2.0 R-band catalog to obtain an astrometric solution and to perform basic photometry to calculate at m_{ROTSE}.

The complete ROTSE-III light curve for J1514 is shown in Figure 1. After outburst, the transient remained bright around $m_{ROTSE} = 17$ for two weeks before fading below our threshold, rebrightened for two days, and faded back to quiescence.

On 18 June, 2004, J1514 was observed in UBVI at the MDM Hiltner 2.4m telescope, on Kitt Peak, Arizona. Two sets of images were taken, with the colors listed in Table 1. Figure 3 shows the I-band image from the 18 June dataset. These colors are consistent with a dwarf nova around minimum light. Furthermore, the variation in the V magnitude between the two observations is statistically significant and not seen in a check star; such flickering is also consistent with a dwarf nova.

On 9 July, 2004, a second CV was detected by the ROTSE-IIId telescope located at Bakirlitepe, Turkey at $m_{ROTSE} = 17.5$, which we designate ROTSE3 J221519.8-003257.2. On 8 July, the previous night, ROTSE-IIId had imaged the same field, and did not detect any object at the transient location to a limiting magnitude of 17.5. The nova faded over the next two days, as can be seen in Figure 2.

Reanalysis of archival ROTSE-IIIb data, which was not previously searched for transients, reveals an earlier outburst on 22 July, 2003 to $m_{ROTSE} = 16.8$. We do not know how long the outburst lasted, since we do not have good images of the field in the following weeks. In addition, the SDSS DR2 (Abazajian, et al. 2004) includes a likely faint counterpart with colors consistent with a dwarf nova at minimum light (Szkody et al. 2002). The SDSS magnitudes are listed in Table 2.

Each of these objects is at a high galactic latitude (48° and −44° respectively), and they each have very dim quiescent counterparts, which is unusual for galactic CVs. However, there have been other such CVs observed (Howell et al. 1997, Szkody et al. 2002), including one discovered by ROTSE-III (Smith et al. 2002). It seems more such CVs have not been found due to selection effects. Although we do not have spectroscopic confirmation, the light curves and quiescent colors of these objects lead us to conclude that these are both galactic cataclysmic variables.

Table 1. The MDM Four-color Intensity Measurements for ROTSE3 J151453.6+020934.2 during quiescence.

UTD	$U-B$	$B-V$	V	$V-I$
040618.33	-1.217 ± 0.046	0.077 ± 0.027	20.055 ± 0.021	0.537 ± 0.038
040618.34	-1.206 ± 0.043	0.124 ± 0.030	20.285 ± 0.022	0.561 ± 0.041

Table 2. The SDSS Five-color Intensity Measurements for ROTSE3 J221519.8-003257.2 during quiescence.

UTD	u'	g'	r'	i'	z'
011015.2	21.44 ± 0.14	21.69 ± 0.06	21.38 ± 0.06	21.25 ± 0.07	20.74 ± 0.18

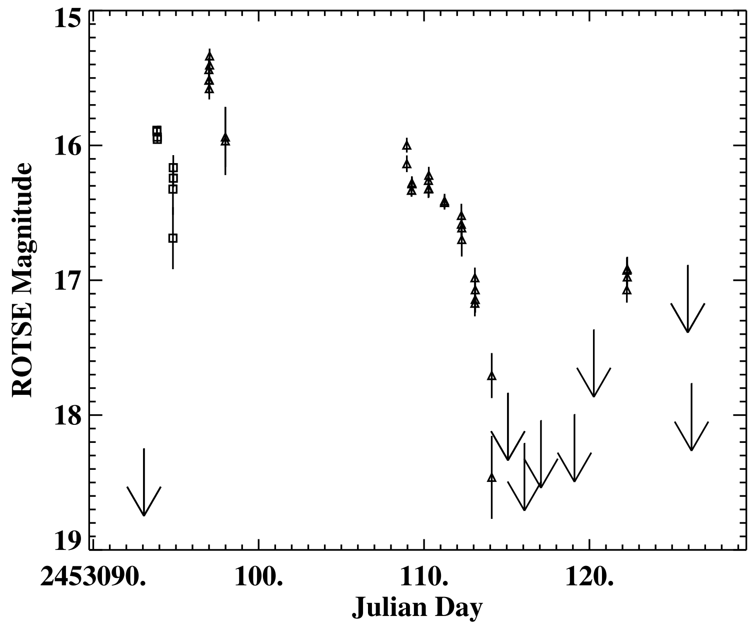

Figure 1. Light curve for ROTSE3 J151453.6+020934.2. The triangles represent data from ROTSE-IIIa and the squares from ROTSE-IIIb. The ROTSE-III unfiltered magnitudes of the object have been calibrated relative to the USNO A2.0 R-band colors of the field stars. Arrows indicate the mean limiting magnitudes of pairs of images in which the source was not detected.

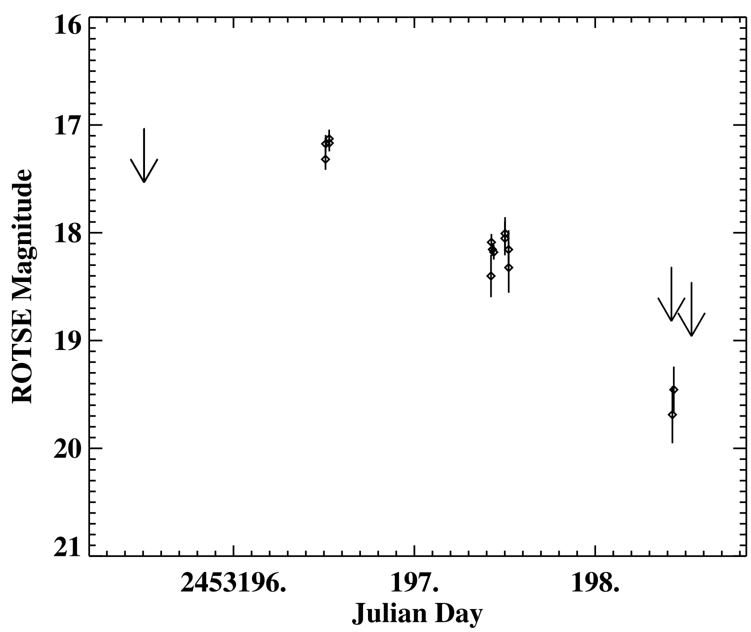

Figure 2. Light curve for ROTSE3 J221519.8-003257.2. The diamonds represent data from ROTSE-IIId. The ROTSE-III unfiltered magnitudes of the object have been calibrated relative to the USNO A2.0 R-band colors of the field stars. Arrows indicate the mean limiting magnitudes of pairs of images in which the source was not detected.

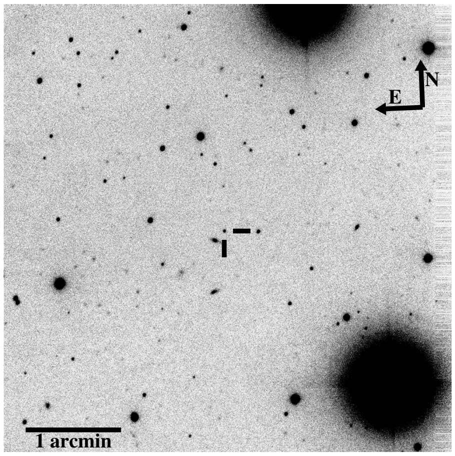

Figure 3. MDM I-band image of ROTSE3 J151453.6+020934.2 during quiescence.

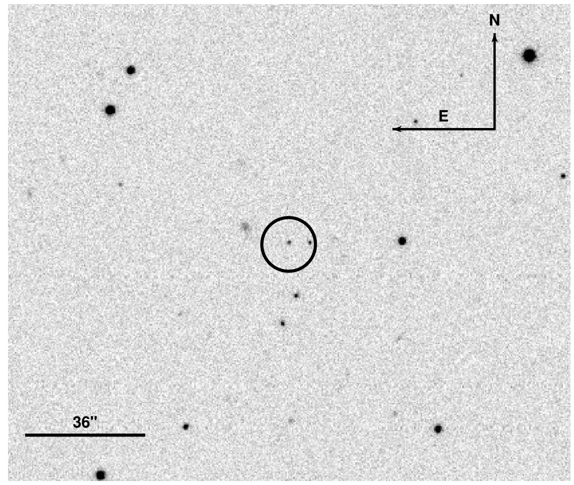

Figure 4. SDSS r'-band image of ROTSE3 J221519.8-003257.2 during quiescence.

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OPTICAL SPECTRUM OF Y Mic

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Y Mic = GSC 07479-01243 = TYC 7479-1243-1 = AAVSO 2100-34 (RA = $21^h07^m06^s$, DEC = -34°16′47″) is an oxygen-rich (Jura & Kleinmann 1992) semi-regular variable with period of 364 d. Neither spectral type nor optical spectra of this star are available in the literature.

Several exposures of this object were taken between 31.07 to 6.08.2003 with the 1.9 m SAAO Radcliffe telescope in Sutherland equipped with grating spectrograph and SITe CCD camera in the range λ 3500 – 9200 Å. A slit 0.250 mm and gratings no. 9, 6, 5 were used. GG495 filter was used during exposures red-ward above 6700Å. A CuAr lamp spectra taken right after stellar spectra was used for wavelength calibration. The spectra were reduced with standard IRAF procedures.

The wavelength range used for spectral classification of Y Mic is presented in Figure 1, where most prominent spectral lines are identified as well. The spectral type of Y Mic is G2 I. The λ 6560 Å hydrogen emission is present in the spectrum of this star. Equivalent widths and FWHM's of most prominent lines are presented in Table 1. No attempt was made to measure radial velocities.

Assuming the relation between interstellar reddening and equivalent width of the 8620Å DIB of Munari (1999) we estimate $E_{B-V} = 0.16$.

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Table 1. Y Mic: EW, FWHM and line center measurements.

Identification	Lambda [λ]	EW [Å]	FWHM [Å]	Notes
CaII 3933	3932.652	12.93	13.73	
CaII 3968	3966.937	9.46	10.16	
FeI 4045	4042.684	0.53	2.30	
SrII 4077	4074.153	1.03	3.21	
HI 4101	4097.920	2.13	4.91	
FeI 4144	4139.469	0.62	2.45	
SrII 4215	4211.166	0.85	2.56	
CaI 4226	4221.216	1.23	4.40	
CH 4300	4292.251	7.17		G-band
FeI 4325	4320.097	0.73	2.48	
HI 4340	4334.431	2.75	6.50	
FeI 4383	4378.840	1.18	3.53	
FeI, TiII 4444	4438.108	1.48	4.59	
HI 4860	4859.715	2.39	5.20	
MgI 5173	5174.062	1.60	4.12	
MgI 5184	5179.190	0.92	3.68	
FeI 5884	5884.063	0.52	2.15	
NaI 5890	5889.929	0.64	2.17	interstellar
NaI 5895	5895.251	0.30	3.23	interstellar
CaI/FeI 6493/5	6495.359	0.75	3.14	
HI 6563	6561.725	0.22	2.22	emission + P Cygni
CaII 8498	8489.574	0.74	1.87	
CaII 8542	8533.801	2.40	2.97	
DIB 8620	8620.624	0.06	1.80	interstellar
CaII 8662	8654.198	1.60	2.19	

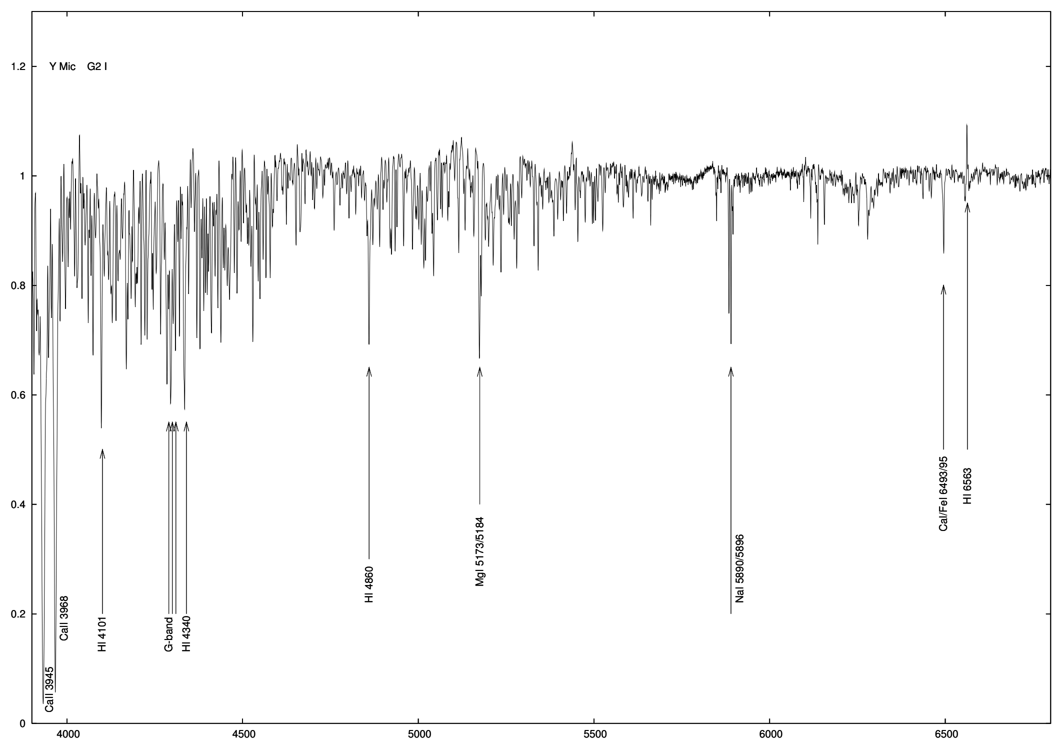

Figure 1. Optical spectrum of Y Mic. Positions of the most significant spectral features are indicated. the intensity scale is relative to the continuum

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POSSIBLE RCB-STAR DY Per: THE CURRENT DECLINE WILL BE DEEP AND NEEDS OBSERVATIONS

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The carbon star DY Per is unique in its light variations. On the long-period variations (JDmax = 2438521+792×E) in the photographic R(0.63)-magnitude range between 9.0 and 10.5, fast light declines similar to those of RCB type stars are superimposed. Since 1963 seventeen cycles of the light variation of the star have been observed (Alksnis, Larionov, Larionova, Shenavrin 2002 and references therein).

During the cycles 1 - 5, 7 - 9 and 16 no fast declines were observed - the star was in a quiescent state. However, in each of the cycles 10, 14, 15, 17 the star exposed one light decline event (typical decline), rather similar to each other, with the minimum of about R(0.63)=12.2 mag at phases 0.5 - 0.55 of the long period variation. During the other cycles - 6th, 11th, and 12th - the deep declines with the R(0.63)-minima of about 14 - 15 mag at phases 0.6 - 0.8 were noticed. The cycle 13 was exceptional - very narrow and with the minimum at R(0.63)=13.0 mag and at the phase 0.64. The deep declines were poorly observed, and up to now we knew nothing of the shape of the light curve for their decline phases.

It seems now that the current decline event of DY Per, which began in early January this year at the phase 0.2 of the 18th cycle, will be a deep one. If so, it will be the first deep decline event of DY Per for which the light curve of the decline phase is documented (Fig. 1). In May-June it looked like the star had reached its minimum light R(0.63)=13.0 at the phase 0.48, slightly too early for the typical decline event, and its light started to recover. In July, however, a new decline event commenced, and at Aug 24 the star had faded down to R(0.63)=13.4, already about 1 mag below the level and slightly after the phase of minima for typical decline events.

Light curve of DY Per in photographic b-magnitude are scarcely covered (Fig. 2), partly because of moonlight and summer night sky brightness. However, it is evident that at faint brightness of the star - R(0.63)>12 mag, b>16 mag - the rate of light decline is significantly smaller in b-magnitude as in R(0.63). Therefore the star, when it is very faint, is significantly bluer than at other phases (Fig. 3), similarly as it is observed for some RCB stars (Rosenbush 1996).

Although light declines of DY Per resemble those of RCB variables, there are differences. Light decline rates of DY Per 0.02 - 0.05 mag/d are at the slower end of the range for typical RCB stars, 0.03 - 0.28 mag/d. Decline events of DY Per began at a specific phase of long-period variations, thus time intervals between RCB-type light declines are multiples of the cycle length 792 d. If DY Per is a variable of RCB-type, it is the coolest of them, and, possibly its 792 d cycle is the longest analogous to pulsational variation of RCB-stars which have periods between 40 and 100 days (Clayton 1996).

Using the MACHO project photometry database Alcock, Allsman, Alves et al. (2001) in the search for RCB-variables in the LMC discovered also four stars (named DY Per type stars), which in their light curve behaviour as well as spectroscopically resemble to DY Per. Light curves for each of the four DY Per type stars in the Large Magellanic Cloud show one light decline event (two for the star 15.10675.10) and pulsational variation from 116 d (the star 15.10675.10) up to 208 d (the star 78.6460.7) (Fig 4). Light decline- and recovery rates of the LMC DY Per type stars, however, are smaller than those of DY Per, decline event profiles are very asymmetrical, except for the star 15.10675.10. The most conspicuous difference between DY Per and LMC DY Per type stars seems to be the very high activity of DY Per. Almost every 792 d cycle from 12th to 17th, except 16th, possibly, pulsational cycles for this 3500 K cool star (Keenan and Barnbaum 1997), triggered the onset of light decline event for DY Per (Fig.4), as for V854 Cen in 1990-91 the pulsational cycle of 43 days (Lawson, Cottrell, Gilmore and Kilmartin 1992).

Keenan and Barnbaum (1997) discuss the spectrum of DY Per near maximum light in detail: it shows some characteristics of RCB-stars - the high-speed ejection of matter, hydrogen deficiency, however, moderate, but shows no evidence of high luminosity. They also find that DY Per has an effective temperature several hundred degrees cooler than those of the coolest known RCB variables.

There are few spectral observations of cool RCB stars in deep decline - the low resolution spectrum of U Aqr by Bond et al. (1979), and a high resolution spectrum of S Aps (spectral type R3) by Goswami et al. (1997).

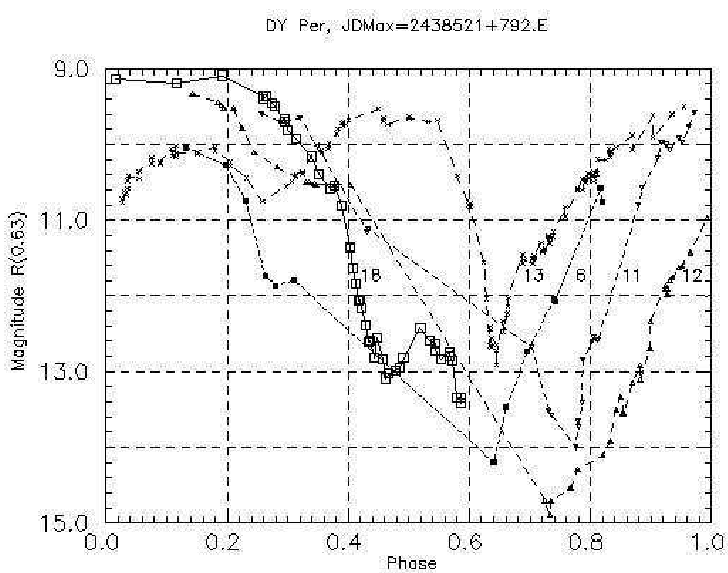

Figure 1. The light curve in the R(0.63) for the current decline event (cycle 18 - open squares) folded with the 792 d period, compared with the previously observed deep decline events in cycles 6 (full squares), 11 (reversed triangles), 12 (triangles) and with the unusual decline event in cycle 13 (crosses).

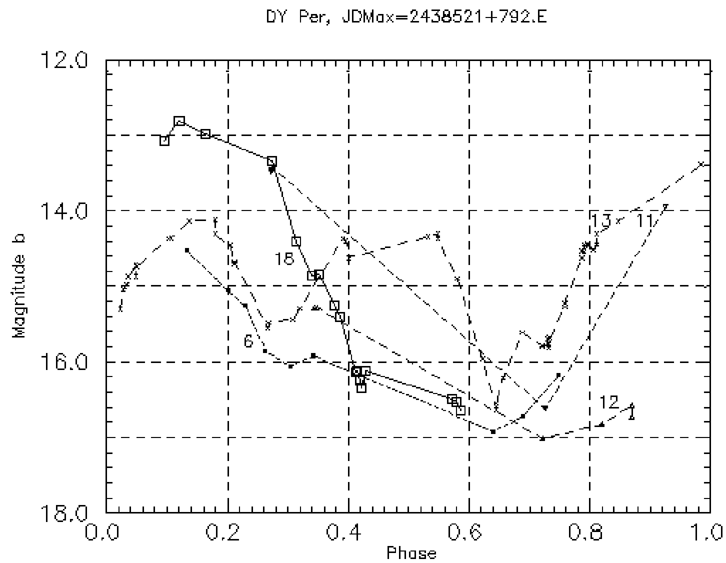

Figure 2. The same as in Fig. 1, but in blue light.

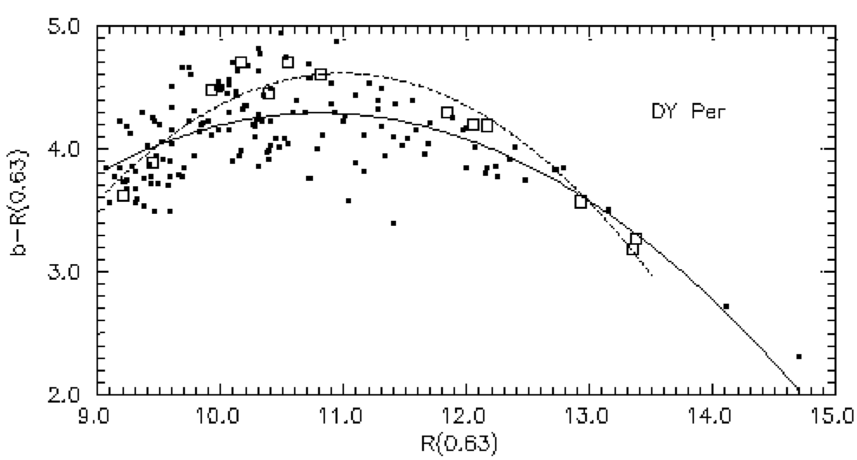

Figure 3. Color - magnitude diagram for the current decline of the cycle 18 (open squares), compared to the earlier data (full squares). Lines - second order polynomials.

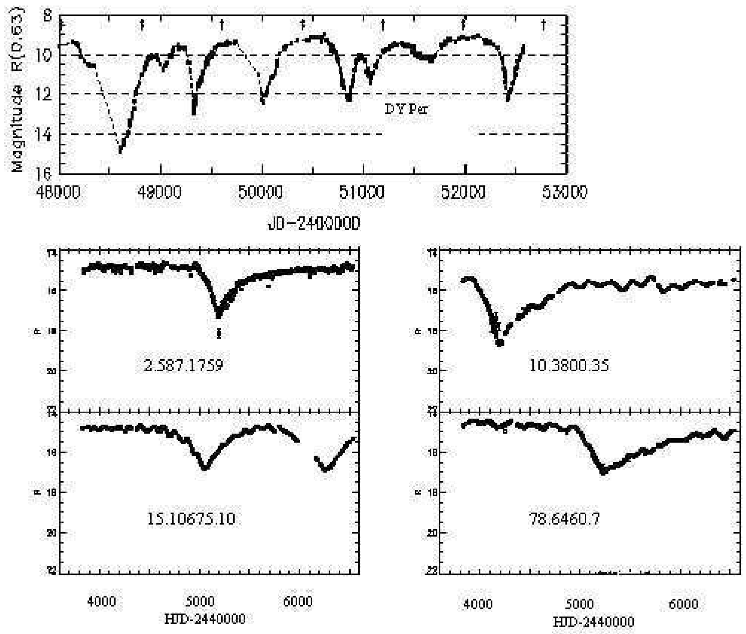

Figure 4. Red light curves of the four DY Per type stars in Large Magellanic Cloud after Alcock, Allsman, Alves et al. (2001) compared with that of DY Per. Time- and magnitude scales are nearly equal for all stars. Daggers mark time of maxima for the 792 d period variation of DY Per.

If we suppose that the recovery phase of the current decline event will be similar to those of the previous deep decline events, DY Per will stay at the present low (R(0.63)>13.4 mag, b>16.5 mag) or even lower light level at least for a couple of months. It would be very important to use the opportunity for the study of this state of the star by spectrographic, polarimetric and infrared observations to search at least for the reasons of the blueing of the star - presence of a companion which dominates the blue light near minimum (Alksnis and Jumike 1990), or bipolar flow, partly obscured by soot clouds as mentioned in the case of S Aps by Goswami et al. (1997).

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RAPID VARIATIONS IN RS Oph OBSERVED BY OMC/INTEGRAL

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RS Oph is a relatively bright symbiotic star with the orbital period $P_{\rm orb} = 460$ days, the inclination angle of $30^\circ - 40^\circ$ and the giant component underfilling its lobe (Dobrzycka and Kenyon 1994). RS Oph is a long-period cousin of cataclysmic variables (CVs) because in contains a white dwarf (WD), as suggested also from the fact that it is a recurrent nova with five observed explosions (e.g. Warner 1995). Beside these outbursts, the quiescent brightness fluctuates on time scales of months and years mostly between 11 and 12 $\rm mag_{vis}$, sometimes reaching 10 $\rm mag_{vis}$ (e.g. Dobrzycka and Kenyon 1994, Oppenheimer and Mattei 1996). Also the rapid optical variations on the time scale of tens of minutes, similar to those often seen in short-period CVs, were reported several times (e.g. Walker 1977, Dobrzycka et al. 1996).

RS Oph was repeatedly observed by the *INTEGRAL* satellite during its Galactic Plane Scans (GPS). Here we report on the observations of this object by the Optical Monitoring Camera (OMC) onboard *INTEGRAL*. This instrument, equipped with Johnson V filter and a CCD detector, is able to carry out rapid photometry (Mas-Hesse et al. 2003). The observing strategy used for GPS consists of so-called *science windows* during which a given region of the sky is observed by the co-aligned instruments for about 1.5 hours. OMC obtains a series of images during this period. Most images used for this study were secured with a 100 sec. exposure time. A smaller part was obtained with a 30 sec. exp. time; these measurements often possess slightly larger observational errors.

The observed light curves are displayed in Figure 1. It can be seen that both night to night and rapid variations of brightness occurred during our observations. In order to allow for a comparison of the amplitude of the variations in the individual science windows (hereafter abbreviated as sets ABCDE), the magnitudes were transformed into intensities, setting the intensity equal to unity at 11.4 mag(V).

A search for the cycle-lengths in the OMC data set was carried out using weighted wavelet Z-transform (WWZ) (Foster 1996). This method, based on the Morlet wavelet, enables one to determine period and amplitude of unevenly sampled time series. WWZ indicates whether or not there is a periodic fluctuation at a given time at a given frequency and is a measure of the confidence of a frequency at a given moment. This method is thus suitable for a search for the periods which undergo variations during the observation. It can be used for discovering possible temporarily existing periods in RS Oph. The value of the parameter c which determines how rapidly the analyzing wavelet decays was set to 0.0125, which is commonly used for variable star light curves. WWZ transform could be made for sets BCDE and the results are shown in Figure 2.

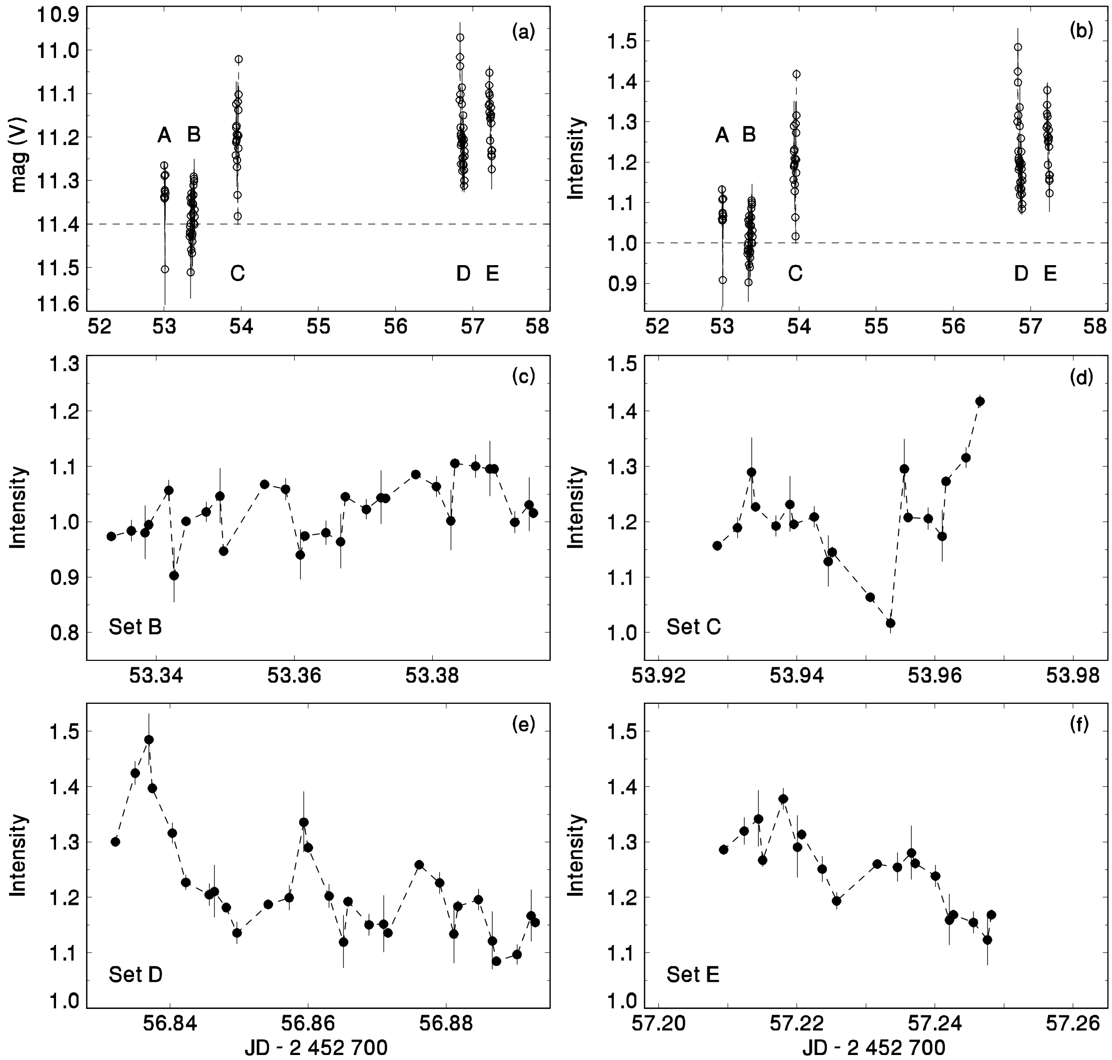

Figure 1. The V band light curve of RS Oph from OMC in the magnitude **(a)** and intensity scale **(b)**. The horizontal dashed line denotes the level in which the intensity was set to unity. The individual sets (science windows) are indicated by the capital letters ABCDE. These sets are plotted on expanded axes in **cdef**. The distances between the ticks on both the abscissa and ordinate are identical for all four panels. The points are connected by the dashed line for convenience to show the profile of the variations. The error bars of the individual measurements are also marked; in some cases the errors are smaller than the size of the symbols.

Our observations were obtained in the orbital phases $\phi = 0.9848 - 0.9935$ according to the ephemeris $T_{\rm icg} = 2450000 + 460\ E$ (Dobrzycka and Kenyon 1994) where $T_{\rm icg}$ refers to the inferior conjunction of the red giant. This implies that our observations were obtained at primary eclipse if RS Oph were an eclipsing system. In spite of the low inclination angle, this is still an important phase because for example the wind flow from the giant toward the WD can still influence our view into the vicinity of the WD.

We observed RS Oph at various levels of brightness, with the lower value close to 11.45 mag(V), the lowest one at which the flickering of this object was analysed previously, as summarized by Anupama and Mikolajewska (1999). We detect rapid variations of the brightness in all sets with sufficiently long coverage (BCDE). The largest peak-to-peak

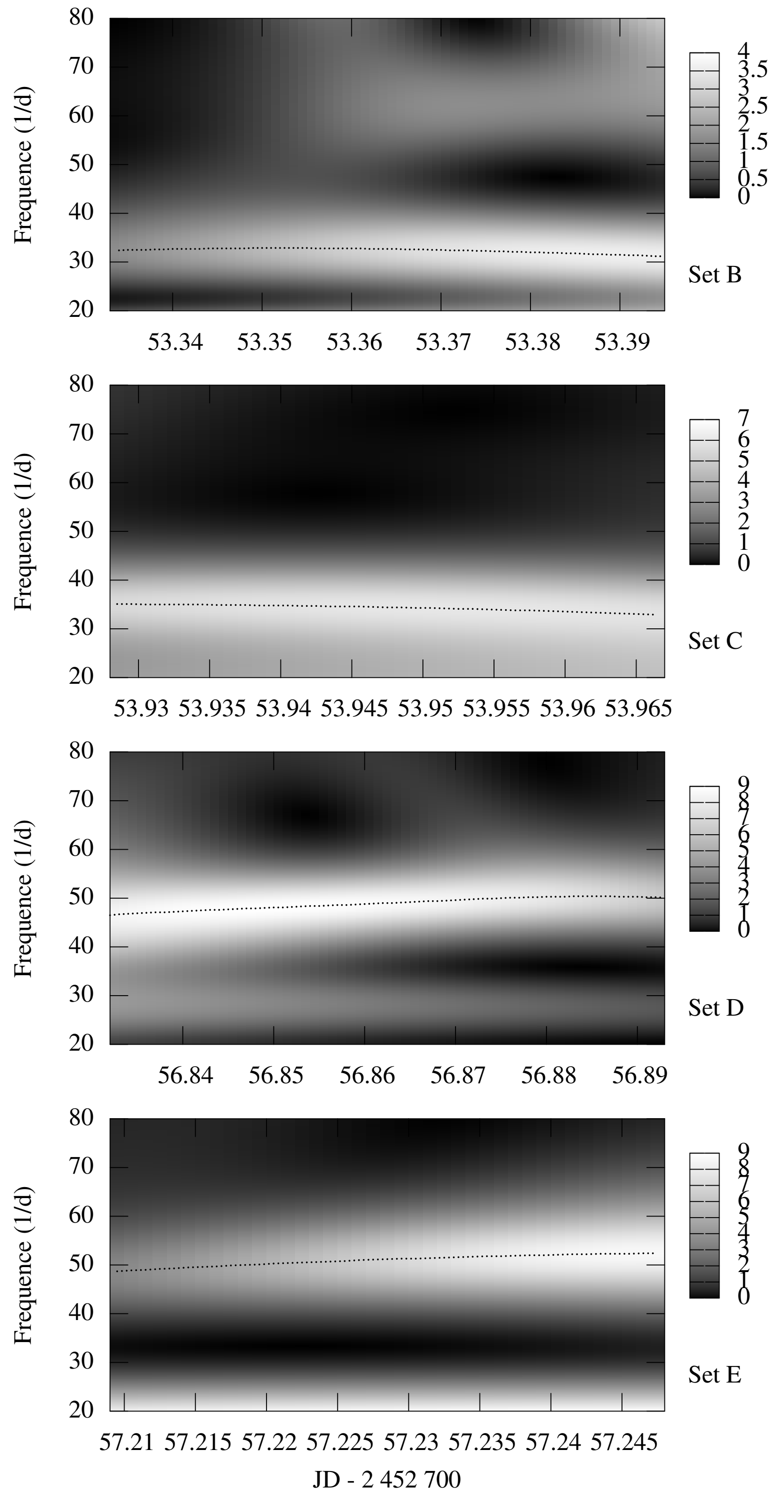

Figure 2. Weighted wavelet Z-transform of the individual sets of RS Oph. WWZ indicates whether or not there is a periodic fluctuation at a given time at a given frequency. The method of Foster (1996) was used. The dotted curves indicate the maximum of WWZ. The range of the ordinate is identical for all four panels while the length of the abscissa for each set corresponds to the length of the given science window of *INTEGRAL*.

amplitudes of about 0.3 mag(V) were observed for sets C and D. The amplitude of the flickering in RS Oph tends to increase with the increasing mean level of intensity. This speaks in favour of the origin of both the flickering and "constant" optical luminosity from the same source. The short time scale of the flickering places its most probable location to the close vicinity of the WD. The interpretation that the inner disk region is the source of the flickering is supported also by the rapid variations of the He II 4686 emission (Sokoloski 2002). We note that the relation between the amplitude of the rapid and long-term variations is in the same sense as the behaviour of CH Cyg (Sokoloski 2002, Sokoloski and Kenyon 2003) and T CrB (Anupama and Mikolajewska 1999). Our observations are also in agreement with Bruch (1992), i.e. that the luminosity of the flickering and "constant" source in CVs are correlated.

WWZ enabled us to detect a typical frequency of the flickering for each of sets BCDE. Although the duration of each set is not long enough to prove the coherence of the frequency over long time scales, we can state that the typical frequency was 30–50 cycles/day (i.e. period of 48–29 min) during our observations. The frequency tends to vary with the varying mean intensity of the sets – set B which possessed a lower mean intensity than sets CDE displayed the flickering with a lower frequency. The frequency displayed the variations also in the course of the set, as can be clearly seen for set D. All this contradicts the origin of the flickering from the rotation of the magnetized WD. We also stress that the typical periods of the flickering found here are quite discordant with the period of 81 ± 2 min reported by Dobrzycka et al. (1996).

We find a complicated relation between the amplitude of a flare in the flickering and its duration. The amplitude decreases with the decrease of the cycle-length (and hence the duration of the flare) in set D (compare Figures 1 and 2). On the contrary, set B which possesses a lower mean intensity level displays a longer cycle-length with a smaller amplitude in comparison with set D. The level of the "constant" intensity thus plays a role in this regard.

Acknowledgements: Based on observations with *INTEGRAL*, an ESA project with instruments and science data centre funded by ESA member states (especially the PI countries: Denmark, France, Germany, Italy, Switzerland, Spain), Czech Republic and Poland, and with the participation of Russia and the USA. The analyzes of cataclysmic variables represent a part of the *INTEGRAL* Core Programme (CP, topic 5.5, responsible scientist R. Hudec). Our study was supported by the project ESA PRODEX INTEGRAL 14527. We made use of the code developed by G. Foster and available at `http://www.aavso.org/data/software/wwz.shtml`.

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COMMISSIONS 27 AND 42 OF THE IAU
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VARIABLE DEPTHS OF MINIMA OF THE ECLIPSING BINARY V685 Cen

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Among eclipsing binaries, there are several cases where the depths of minima change (IU Aur, SS Lac, RW Per, V907 Sco), or which are not “eclipsing” binaries at present (SV Cen, AY Mus); see e.g., Mayer (2004). The reason of these changes is most probably precession of the orbital plane due to a third body in the system, i.e., a change of orbital inclination. Knowledge of these cases is important for studies of multiple systems, and any addition of a further case to the existing sample is of great interest. New cases may be found when light curves obtained terrestrially decades ago are compared with more recent light curves – usually produced by satellites or by large-size surveys.

We found a change of amplitude for the eclipsing binary V685 Cen (HD 99218, HIP 55675) when comparing photometry done 27 years ago, with data obtained by ASAS 3 (Pojmański 2002). The original Walraven $VBLU$ photometry was obtained by van Houten using the 90 cm telescope of the Leiden Southern Station in South Africa. The photometry was published recently by van Houten et al. (2003). New ephemeris and light-curve solution was published by Chochol et al. (2003).

The V magnitude of this star is 8.83 in maximum, the period is $1\overset{d}{.}191$ and spectral type is A0. The star was measured also by HIPPARCOS (ESA 1997). In Fig. 1, the V light curves of V685 Cen from available sources are displayed; the ephemeris according to Chochol et al. (2003) is used:

$$\mathrm{Prim.\ Min.} = \mathrm{HJD}\ 2443586.3313 + 1\overset{d}{.}19096085 \times E.$$

The HIPPARCOS magnitudes were transformed to the V values using a formula by Harmanec (1998). Since $B-V = 0.00$ – this value corresponds to $(V-B)_{\mathrm{Walraven}} = 0.006$ (found by Chochol et al. 2003) according to Brand & Wouterloot (1988) – and $U-B$ has also be close to zero due to the A 0 spectral type (the exact value being unimportant since the coefficient in the transformation equation is small), the correction is only +0.007.

From the values offered by ASAS the $mag2$ were used, since their scatter is the smallest and also $mag2$ magnitude of the comparison star HD 99415 (8.99) equals to its V magnitude according to Deutschman et al. (1976). Therefore, the differential data of van Houten et al. were shifted adding 8.99 mag. Note that ASAS 3 data are given as magnitudes determined in diaphragms of four various sizes, from diameter 28 to 112 arcsec. ASAS 3 data with errors larger than 0.030 mag were discarded; 237 measurements have been left.

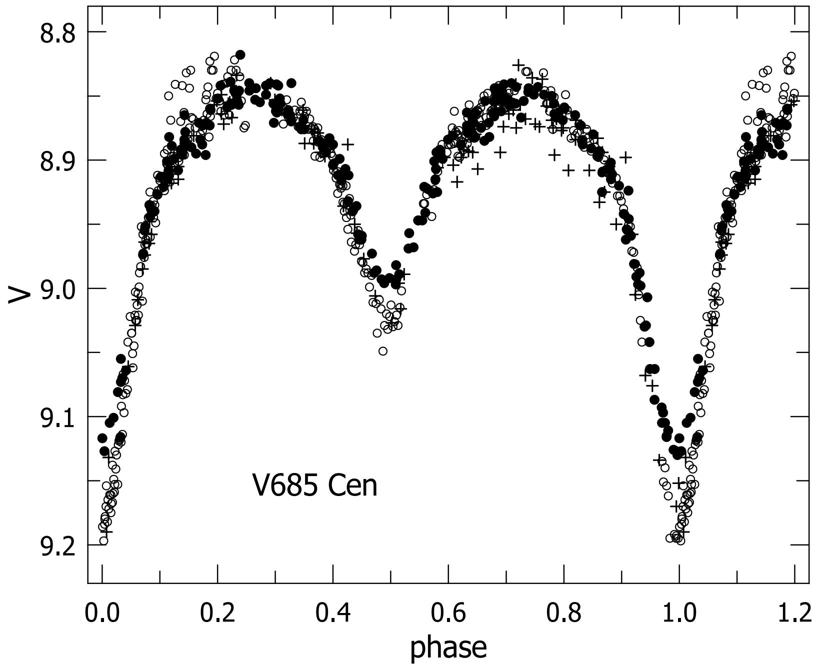

Figure 1. V light curves of V685 Cen. Dots – ASAS 3, crosses – HIPPARCOS, circles – van Houten.

The time intervals covered by these sources, and the respective depths of primary and secondary minima are:

- van Houten: from JD 2443249 to 2443599 (centre JD 2443450); depths 0.35 and 0.25 mag
- HIPPARCOS: from JD 2447884 to 2448969 (centre JD 2448500); depths 0.32 and 0.23 mag
- ASAS: from JD 2451807 to 2453223 (centre JD 2452500); depths 0.28 and 0.21 mag

The time of the minimum according to HIPPARCOS is 2448500.2358 and fits exactly the ephemeris ($O-C=0$ for $E=4126$). The ASAS data give $O-C=-0\overset{\mathrm{d}}{.}0023\pm10$ for $E=7484$, therefore their phases are shifted by +0.0019 in Fig. 1.

The variability of the star was discovered by Uitterdijk; Uitterdijk & van Houten (1960) gave depths (photographic) of minima as 0.4 and 0.1 mag. The star was observed also as BV 724 (Strohmeier et al. 1965); only the depth of one minimum (0.2 mag) was given there. These photographic depths of minima are probably too uncertain and cannot be used for a discussion of the long time scale behaviour of the V685 Cen light curve.

The smaller amplitude in the ASAS database might be a result of including into this photometry also a visual component (which would be out of the diaphragm when the star was measured by a photomultiplier). To explain the observed depth change that companion should be 1.6 mag fainter than V685 Cen. According to GSC, there is a companion, magnitude 10.9, 75 arcsec apart. This companion should however not be included in the ASAS photometry, since the diameter of the aperture called “2” is 56 arcsec. There is also no dependence of the depth of the minima on the diameter of the aperture.

The change of the minimum depths is probably real, and its reason is most likely the change of the orbital inclination, as noted above. If this explanation is correct, a third light might be present in V685 Cen. A solution of the photometric elements was attempted by Chochol et al. (2003). In this solution, the authors tried to remove discrepancies in the light curve fitting by an increase of temperature of the primary component. The presence of a third light might however be a more natural reason of the discrepancies.

Therefore, we repeated the light-curve solution, using this time the code ROCHE (written by TP; Pribulla 2004). As soon as non-zero third light was allowed, better fit of light curves was obtained, and also the resulting parameters were more acceptable than in the original solution without the third light. As it is common in similar cases, the correlation between the amount of the third light and inclination was strong, the matter being worse in this case due to unknown mass ratio $q = m_2/m_1$. We assumed the primary component temperature $T_1 = 11900$ K found by Chochol et al. (2003) and model atmospheres with $g = 3.5 - 4.0$.

Trying solutions with q in a wide interval (from 0.2 to 2.2) we observe, that:

1. in V, l_3 rises from 0.25 to 0.58 ($l_1 + l_2 + l_3 = 1$), but not monotonically; always l_3 is lower in other bandpasses, i.e., the third light is redder than the light of the binary;
2. sum of squares of residuals reaches its minimum for $q = 1.25$; however, it changes in a small interval only (between 0.0265 and 0.0231) and cannot discriminate among solutions;
3. for approximately $0.40 < q < 1.10$, the configuration is semidetached, with the secondary component filling its Roche lobe;
4. as it could be expected, for larger l_3 also inclination is larger, increasing approximately from 79° to 84°; inclination for ASAS data is always about 5° smaller;
5. temperature of the secondary component is always close to $T_2 = 8200$ K, the corresponding spectral type being A5 .

In case the system is detached, one could assume that all three components are normal stars, then the mass-luminosity relation could be applied. However, e.g. for $q = 0.38$ the solution gives bolometric luminosity of the secondary component as $L_{2,\mathrm{bol}} = 0.148\, L_{1,\mathrm{bol}}$, but according to the L/M relation, $L_{2,\mathrm{bol}}$ should be only 0.03. By other words, the secondary component radius is too large for a main sequence star. Therefore, the semidetached configuration, with the secondary component filling its Roche lobe, seems to be more probable since in such a case the secondary components are commonly overluminous by about a magnitude (bolometric); for V685 Cen, such an overluminosity appears for $q = 0.50$. Also the sum of squares of residuals is smaller for these configurations in our solutions. The system was classified as SD also by Svechnikov & Kuznetsova (see Budding et al. 2004, Table 6d).

As already noted, the third component spectral type appears to be somewhat later than the primary component one. If both are to be main-sequence stars, then $L_3 < L_1$, which in our solutions happens for $q < 0.38$.

With the inclination changing by 5° in a quarter of a century, the period of the orbital precession might be of the order of several centuries, which means, that the orbital period of the third body would be under one year. Then the eclipsing binary should display light-time effect with this period, and with the semiamplitude of several minutes; the semiamplitude of course depends on the long-orbit inclination (this inclination being close to zero, amplitude would be also close to zero). The presently available photometry does not allow to find the effect.

It seems to be of great interest to confirm that the depths of minima change by a more precise photometry than can be offered by ASAS; and to confirm the expected third light spectroscopically, finding the lines of a tertiary component in the spectra. The high dispersion spectroscopy and the method of spectra disentangling will allow to determine the spectral type of each component and its contribution to the total light of the system as well as to find the mass ratio of the binary. Then it will be easy to find the appropriate solution of the multicolour light curve analysis.

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ERRATUM FOR IBVS 5503

HV 11094 is specified by Mayall to lie 'south preceding CoD −36 1043'; in addition there is a finder chart that matches this description. This makes the identification with the red star there certain, despite its evident faintness in DSS images. Thus

```
IRAS 02443-3626 = NSV 917 at: 2 46 21.09  -36 13 35.6 (J2000, 2MASS).
```

In the same field, the star given by Kamath as CD−36 1043 is actually CD −36 1041 = CPD −36 282, which is correctly catalogued in SIMBAD. The true

```
CD-36 1043 = TYC 7017-880-1 = NSV 919,
```

about 20″ northeast of IRAS 02443-3626, also correct in SIMBAD. The faint red star to the southwest ($2^h45^m00\overset{s}{.}6$; $-36°16'11''$) seems to be unrelated to any of these; it is probably a distant M dwarf.

Kamath has also misidentified HV 11102, which is the relatively bright star and IRAS source IRAS 14265-6254. Again, Mayall provides a chart which makes the ID unambiguous:

```
SV* HV 11102 = IRAS 14265-6254 = GSC 9010-4846 = NSV 6681:
          at: 14 30 28.06  -63 07 45.5 (J2000, 2MASS)
```

Finally, there appears to be a −20″ Dec typo for the coordinates of HV 11105. This should be given as: $18^h03^m28\overset{s}{.}86$; $-41°54'03\overset{''}{.}2$ (J2000, UCAC2). There is no star at Kamath's position.

Brian Skiff

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CCD LIGHT CURVES OF ROTSE1 VARIABLES, XXIII: GSC 3510:5 Her, GSC 3097:1297 Her, GSC 3101:547 Her AND GSC 3106:1368 Her

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Observatory and telescope:
Private observatory Schüsselacher, Wald, 0.15-m Starfire refractor

Detector:	SBIG ST-7 CCD camera

Method of data reduction:
Standard CCD-frame reduction using AIP4WIN software

Method of minimum determination:
Kwee – van Woerden algorithm

Observed star(s):

Star name	GCVS type	Coordinates (J2000) RA	Dec	Comp./check star(s)
GSC 3510:5				
ROTSE1 J174737.00+450213.9	EW	17 47 37.0	+45 02 14	GSC 3510:19 / GSC 3510:71
GSC 3097:1297				
ROTSE1 J175307.55+423434.0	EW	17 53 07.6	+42 34 34	GSC 3097:429 / GSC 3097:153
GSC 3101:547				
ROTSE1 J175535.77+434820.8	EW	17 55 35.8	+43 48 21	GSC 3101:1105 / GSC 3101:1481
GSC 3106:1368				
ROTSE1 J180025.53+401103.3	EW	18 00 25.5	+40 11 03	GSC 3106:744 / GSC 3106:250

Ephemeris:

Star name	E 2400000+	P [day]	Source
ROTSE1 J174737.00+450213.9	53154.4451	0.349231	present paper
ROTSE1 J175307.55+423434.0	53121.5547	0.370365	”
ROTSE1 J175535.77+434820.8	53229.5522	0.369881	”
ROTSE1 J180025.53+401103.3	53229.5386	0.358398	”

Times of minima:

Star name	Time of min. HJD 2400000+	Error	Type	Filter	$O-C$ [day]	Rem.
GSC3510:5 (Her)	51341.7374	4	s	none		ROTSE1
	51352.7842	20	p	none		ROTSE1
	53121.620	4	p	none		
	53143.4439	11	s	none		
	53150.4239	10	s	none		
	53154.4479	12	p	none		
	53173.4762	15	s	none		
	53229.353	3	s	none		
	53229.5333	12	p	none		
	53250.4850	12	p	none		
GSC3097:1297 (Her)	51322.8758	7	s	none		ROTSE1
	51332.6910	3	p	none		ROTSE1
	53121.5543	6	p	none		
	53143.4064	10	p	none		
	53150.4440	10	p	none		
	53154.5175	5	p	none		
	53173.4054	6	p	none		
	53203.4050	5	p	none		
	53229.5160	5	s	none		
	53250.4417	7	p	none		
GSC3101:547 (Her)	51358.6965	8	p	none		ROTSE1
	51364.7978	9	s	none		ROTSE1
	53121.5467	5	p	none		
	53143.3703	19	p	none		
	53150.3981	6	p	none		
	53150.5821	15	s	none		
	53154.4662	5	p	none		
	53173.5150	3	s	none		
	53203.4748	5	s	none		
	53229.3671	25	s	none		
	53229.5524	10	p	none		
	53250.4519	8	s	none		
GSC3106:1368 (Her)	51361.7560	18	s	none		ROTSE1
	51600.969	3	p	none		ROTSE1
	53150.5167	11	s	none		
	53154.4579	17	s	none		
	53173.4518	5	s	none		
	53229.356	22	s	none		
	53229.5364	15	p	none		
	53250.3218	7	p	none		
	53250.5045	10	s	none		

Explanation of the remarks in the table:

ROTSE1: Observations of Akerlof et al. (2000).

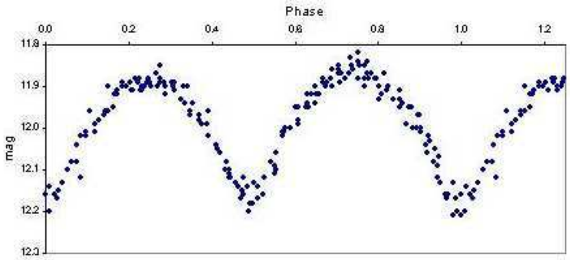

Figure 1. CCD light curve (without filter) of GSC 3510:5

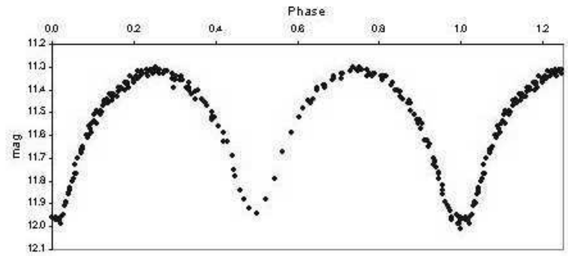

Figure 2. CCD light curve (without filter) of GSC 3097:1297

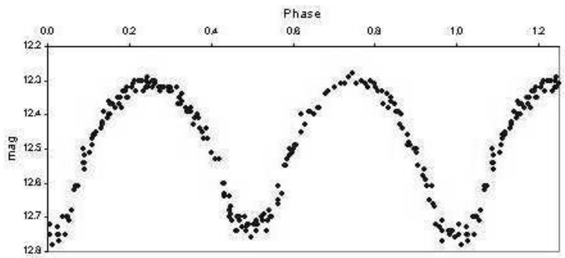

Figure 3. CCD light curve (without filter) of GSC 3101:547

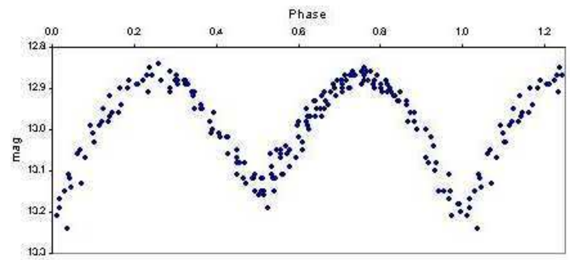

Figure 4. CCD light curve (without filter) of GSC 3106:1368

Remarks:

As a byproduct of the ROTSE1 CCD survey, a large number of new variables have been discovered (Akerlof et al., 2000). In a series of papers, we report unfiltered CCD observations for some of the close binary systems (type EW) in the list of Akerlof et al. (2000). This installment contains information on four variables in the constellation Hercules. The four stars were observed with our CCD equipment during eight nights between JD 2453121 and JD 2453250. A total of 190 CCD frames were measured of GSC 3510:5, 219 frames of GSC 3097:1297, 215 frames of GSC 3101:547 as well as 197 frames of GSC 3106:1368. Figures 1 through 4 show our observations folded with the elements given in the Table of Ephemeris. These elements of variation are deduced from a linear fit to the normal minima from the ROTSE1 data and the timings of minimum derived from our data given in the table of Times of minima.

Availability of the data:

Upon request from diethelm@astro.unibas.ch

Acknowledgements:

This research made use of the SIMBAD data base, operated at CDS, Strasbourg, France

Reference:

Akerlof, C., Amrose, S., Balsano, R., Bloch, J., Casperson, D., Fletcher, S., Gisler, G., Hills, J., Kehoe, R., Lee, B., Marshall, S., McKay, T., Pawl, A., Schaefer, J., Szymanski, J., Wren, J., 2000, *AJ*, **119**, 1901

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CCD PHOTOMETRY T UMi, SZ Aur, UV Aur, RU Lyr, RV Peg, SX Peg

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Observatory and telescope:
Valašské Meziříčí Observatory, Astrocamera ZEISS 120/540 mm, Schmidt-Cassegrain 280/1764 mm telescope

Detector:	SBIG ST-7 camera

Filter(s):	V, R

Observed star(s):

Star name	GCVS type	Coordinates (J2000) RA	Dec	Comp. star	Ephemeris E 2400000+	P [day]	Source
T UMi	M	13 34 41.1	73 25 53			301.1	
SZ Aur	M	05 41 56.6	38 55 56			454.04	
UV Aur	M	05 21 48.6	32 30 41			394.42	
RU Lyr	M	19 12 20.9	41 18 13			371.84	
RV Peg	M	22 25 37.9	30 28 22			396.8	
SX Peg	M	22 50 25.2	17 53 36			303.6	

Transformed to a standard system:	No

Date(s) of the observation(s):
T UMi filter V: 2002.02.15 – 2004.08.19; filter R: 2003.06.27 – 2004.08.19; SZ Aur filter V: 2003.08.27 – 2004.05.20; filter R: 2003.08.27 – 2004.05.20; UV Aur filter V: 1999.01.18 – 2004.02.20; filter R: 2003.08.15 – 2004.02.20; RU Lyr filter V: 2003.06.22 – 2003.11.04; filter R: 2003.06.22 – 2003.11.04; RV Peg filter V: 2003.09.05 – 2004.01.06; filter R: 2003.06.27 – 2004.01.06; SX Peg filter V: 2003.07.27 – 2003.10.18; filter R: 2003.07.27 – 2003.10.18

Comparison star(s):	T UMi - GSC 4408 1329, $V = 12.7^{\rm m}$; SZ Aur - GSC 2911 23, $V = 10.62^{\rm m}$, $B-V = 0.235^{\rm m}$; UV Aur - GSC 2394 313, $V = 11.87^{\rm m}$, $B-V = 0{,}324^{\rm m}$; RU Lyr - GSC 3125 334 = HIP 94354 = PPM 58001 = SAO 48191 = HD 179869 = BD +40 3624, $V = 7.13^{\rm m}$, $B-V = 1.543^{\rm m}$; RV Peg - GSC 2734 1070 = PPM 87764 = BD +29 4659, $V = 10.62^{\rm m}$, $B-V = 0.990^{\rm m}$; SX Peg - GSC 1702 1270 = HIP 112821 = PPM 141914 = SAO 108214 = HD 216219 = BD +17 4818, $V = 7.44^{\rm m}$, $B-V = 0.653^{\rm m}$

Remarks:
Maxima and minima timings are determined using the Kwee and von Woerden (1956) method implemented in AVE (Barbera, 2000) and their values are given in the following table.

Table 1: Maxima timings

Star name	Geo. JD	Error	
T UMi	2452436.2	0.2	filter V
	2452664.2	0.2	filter V
	2452705.7	0.1	filter V double maximum
	2452923.1	0.1	filter V
	2452929.9	0.1	filter R
	2453122.4	0.2	filter V
	2453121.2	0.2	filter R
RU Lyr	2452864.6	0.1	filter V
	2452865.0	0.1	filter R
RV Peg	2452929.6	0.1	filter V
	2452954.8	0.1	filter R
SX Peg	2452893.9	0.2	filter V
	2452896.9	0.2	filter R

Availability of the data:
Through the IBVS website as 5565-t2.txt to 5565-t13.txt

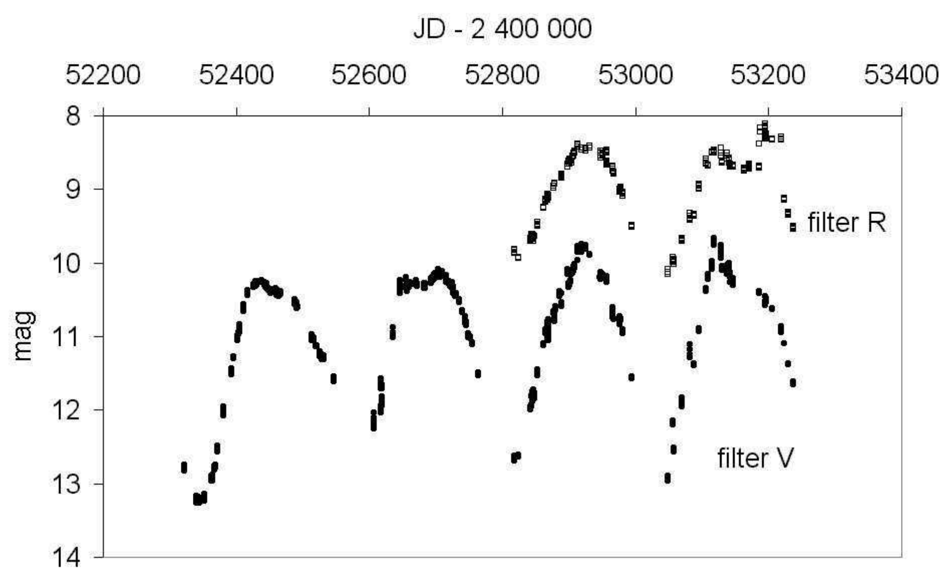

Figure 1. Light curve T UMi (filter V,R).

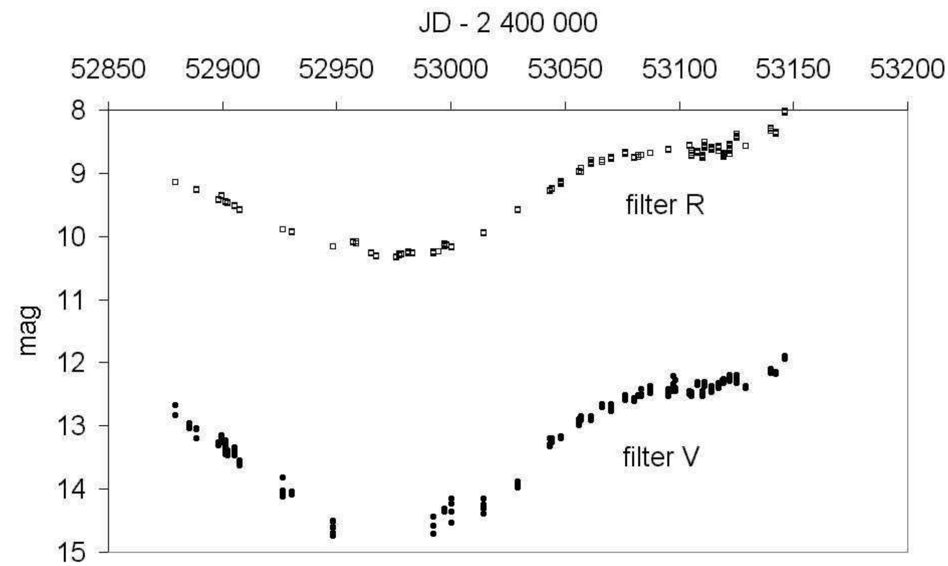

Figure 2. Light curve SZ Aur (filter V,R).

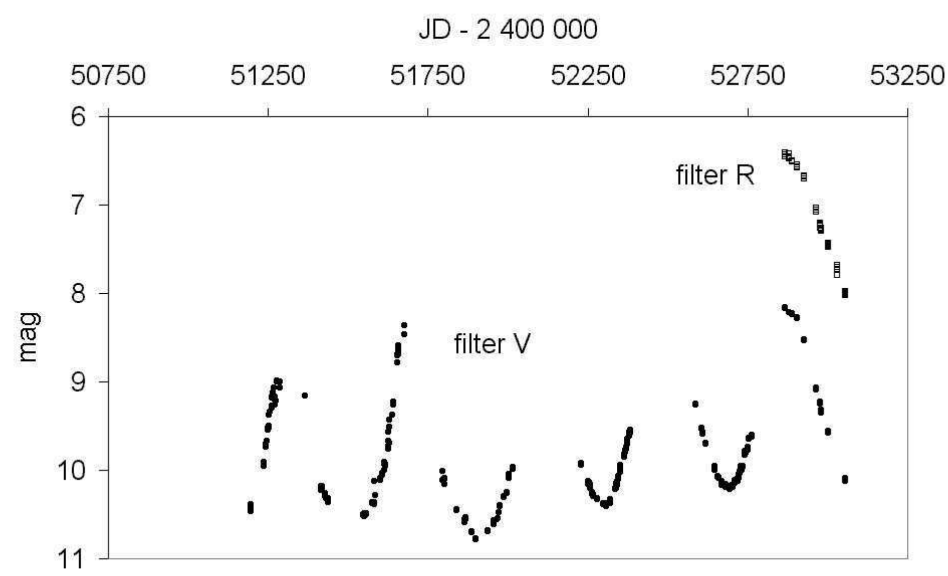

Figure 3. Light curve UV Aur (filter V,R).

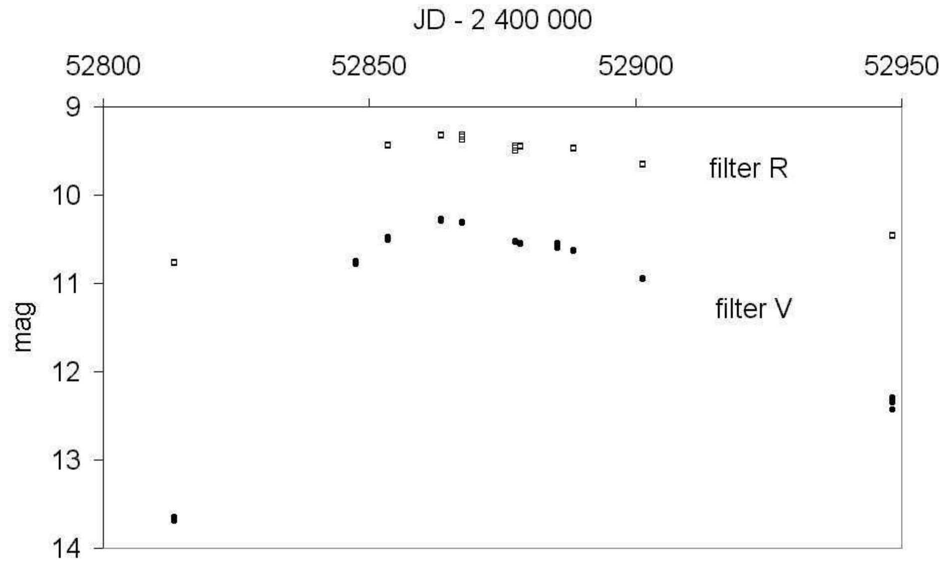

Figure 4. Light curve RU Lyr (filter V,R).

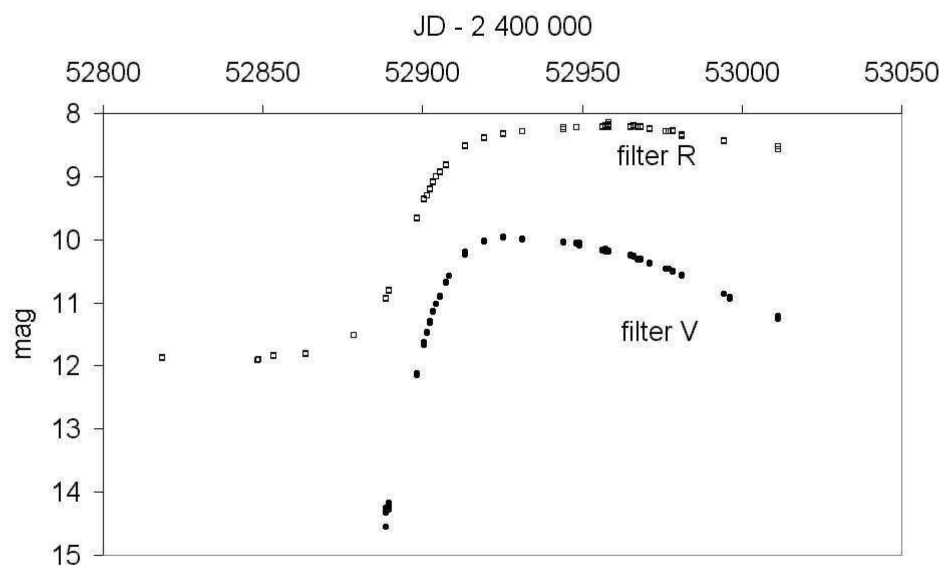

Figure 5. Light curve RV Peg (filter V,R).

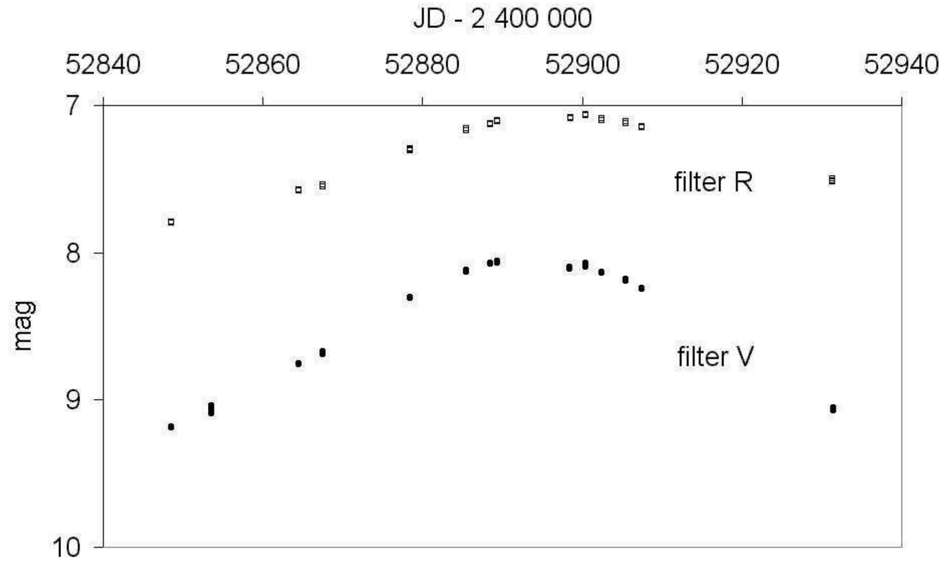

Figure 6. Light curve SX Peg (filter V,R).

Acknowledgements: This work has made use of the SIMBAD database, operated at CDS, Strasbourg, France. The NASA ADS Abstract Service was used to access data and references.

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A HIGH-RESOLUTION SPECTRUM OF THE TrES-1 PARENT STAR

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The Trans-Atlantic Exoplanet Survey (TrES) network have just announced their first discovery of a transiting planet in front of the bright parent star GSC02652-01324 (Alonso et al. 2004). The planet has been designated TrES-1 and has a mass of 75% of Jupiter and a radius of 1.08 Jupiter radii. The orbital period is 3.030065 days. This makes the TrES-1 system similar to HD209458b (Charbonneau et al. 2000, Henry et al. 2000) except for maybe its radius which is 20% smaller than HD209458b. As has been mentioned by several authors in the past, the diverse nature of exoplanets and their evolutionary status can only be understood if the astrophysical parameters of the parent star become known to very high precision.

In this note we present a single high-resolution (R=120,000) spectrum of the parent star in a 10nm wide wavelength region centered at 671nm (Fig. 1). Our intention is to determine the lithium and iron abundance of the host star and to obtain an accurate value of its rotational line broadening. Alonso et al. (2004) have already obtained "moderate resolution" spectra of GSC02652-01324 at Palomar and Keck and classified the star as a single K0V star with $v \sin i \leq 5$ km s^{-1} and with solar metallicity. Our spectrum of the neutral lithium line 670.8nm may also allow a rough estimation of the age of the star and, somewhat indirectly, an estimate of whether there is photospheric surface activity or not. Starspots tend to deform spectral line profiles while the star rotates. In the worst case this can even mimic radial velocity and photometric variations with amplitudes of the order observed for the transit of a planet. Moreover, the extremely short orbital period of TrES-1 of just 3 days suggests that interaction with the parent star via a magnetic field and its associated flaring and heating is most likely (e.g. Cuntz & Shkolnik 2002).

We used the 3.6m CFH (Canada-France-Hawaii) telescope and the fiber fed f/8 *Gecko* spectrograph on the night of UT Aug. 31st, 2004. *Gecko* provides a spectral resolution of 120,000 in 8th order and, with the 4600×2048 13.5μm-pixel EEV1 CCD, gives a 10nm wide wavelength range. A total of 5×900 sec exposures enabled a signal-to-noise ratio of around 100:1 per pixel. Spectra of 70 Oph A (K0V; well separated from the K4 B-component) and HD166620 (K2V) were used as comparisons. All data reductions and analysis were carried out with IRAF and included bias subtraction, flat fielding, optimal aperture extraction, wavelength calibration with a Th-Ar comparison, and continuum setting with a low-order polynomial fit.

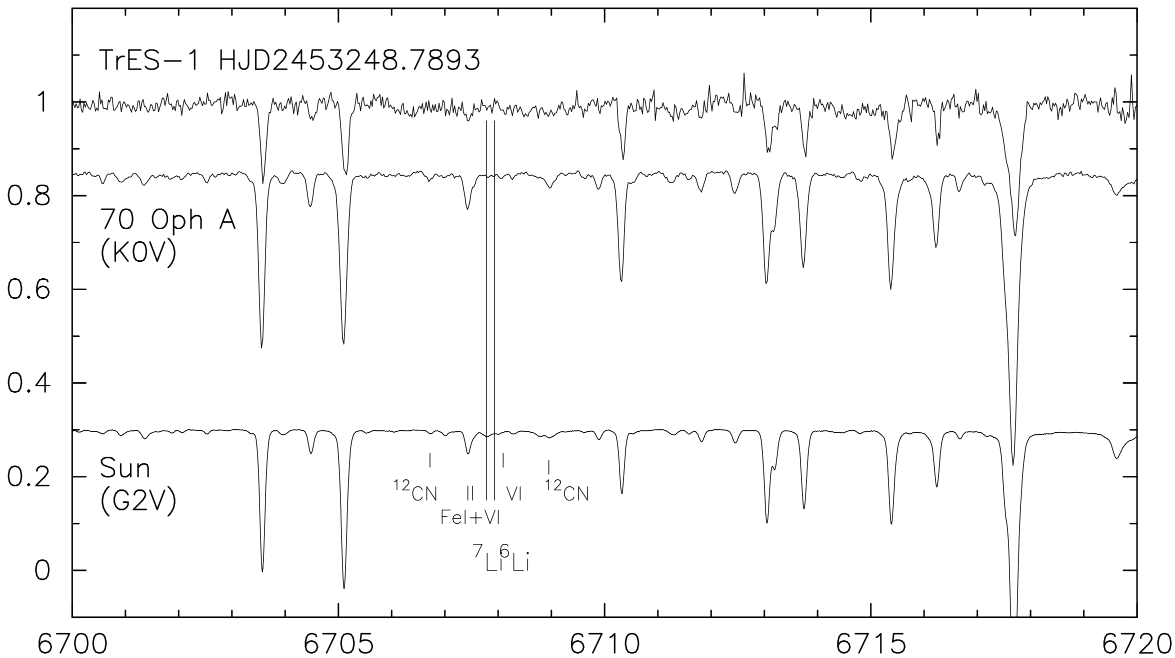

Figure 1. R=120,000 spectrum of the lithium region of the TrES-1 parent star (top). The other spectra are comparisons and arbitrarily shifted. Middle spectrum: the K0V-standard star 70 Oph(A) obtained with the same equipment. Lower spectrum: a R=600,000 spectrum of the Sun.

Cross correlating the TrES-1 spectrum with 70 Oph(A) (v_r=–10.4±0.5 km s^{-1} ; Nordström et al. 2004) yields a radial velocity difference of –14.76±0.20 km s^{-1} at the time of observation HJD2453248.726.

Rotational line broadening was measured by several techniques. Firstly, we determine a FWHM of 0.113 Å from several unblended lines like Fe I 6703.56Å, Fe I 6713.77Å etc. and the calibration of FWHM and $v \sin i$ from Fekel (1997). Secondly, the width of the cross-correlation function with respect to 70 Oph(A) ($v \sin i$=3.1 km s^{-1} , Fekel 1997; 1.6–2.6 km s^{-1} , Gray 1984) is used as a comparison (see Griffin 1991) and, thirdly, a line-profile fit with a synthetic model (see below). The "best" weighted average value is $v \sin i$(TrES-1)=2.8±0.2 (rms) km s^{-1} with an adopted macroturbulence of 2.0 km s^{-1} and a microturbulence of 0.5 km s^{-1} , appropriate for a K0V star (taken from Fekel 1997).

Line equivalent widths were measured with the `splot` routine in IRAF. An upper limit for the Li I 670.8-nm equivalent width is 2.3±0.2 mÅ as compared to 6 mÅ for the nearby Fe I/V I blend. The upper limit for 70 Oph(A) is even smaller, 1.5±0.2 mÅ. The uncertainty of just 0.2 mÅ is estimated from different types of fits to the line profile, e.g. with a Gaussian profile of variable width where only the profile points of the red profile wing are used for the least-squares fit, from a normal Gaussian fit or from a simple profile-area integration. For the well-studied K0V star 70 Oph(A), the Fe I/V I blend on the blue side of the Li line amount to 11.5 mÅ. Our upper-limit Li equivalent width for TrES-1 is still the sum from the two isotopes ^{6}Li and ^{7}Li that remain unresolved in our spectra. The non-LTE curves of growth of Pavlenko & Magazzú (1996) for a 5250 K/$\log g$ =4.5 model convert an equivalent width of 2.3 mÅ of a K0 dwarf into a Li abundance of <1.0 (on the $\log n$(H)=12.00 scale). Using the same abundance scale, the observed solar photospheric Li abundance listed by Grevesse & Sauval (1998) is 1.16±0.1, and the Li 670.8-nm line appears to have an equivalent width of around 2 mÅ as measured from daylight spectra with the same setup (Strassmeier et al. 1999). This indicates that the upper limit given above for Li in TrES-1 is reasonable.

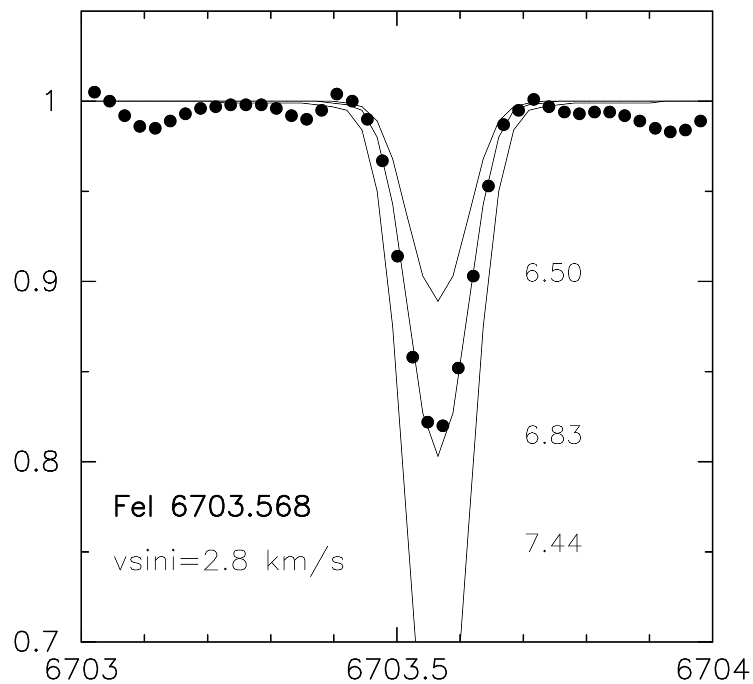

Figure 2. Synthetic fits to the observed (dots) Fe I 6703.568-Å line profile of TrES-1. Shown are fits with three logarithmic iron abundances of 6.50, 6.83, and 7.44 (=solar). The best fit is with 6.83±0.02.

Various line ratios of TrES-1 clearly resemble 70 Oph(A) but individual lines show residual intensities weaker by a factor ≈2, e.g., the unblended Fe I 6703.568Å has an equivalent width of 22.1±1.5 mÅ and a residual intensity of 0.826 in TrES-1 but 53.5±1.0 mÅ and 0.625 in 70 Oph(A), respectively (the equivalent width errors come again from various types of fits to the line profiles but are larger here because of line asymmetries due to unresolved blends). This suggests a significantly lower metallicity for TrES-1 than for 70 Oph(A). Note that Nordström et al. (2004) already list [Fe/H]=–0.25 for 70 Oph(A). Therefore, we computed synthetic fits for parts of the TrES-1 spectrum using the TempMap code (Rice 2002) with a $\log g$=4.5 and $T_{\rm eff}$=5250-K ATLAS-9 atmosphere (Fig. 2). We first fit a R=600,000 spectrum of the Sun to verify or revise some of the transition probabilities of weaker lines from current line lists, e.g., Kurucz (1993) lists $\log gf$=–3.160 for Fe I 6703.568Å, which we revise to –3.050. A minimization of the O-Cs then yields a logarithmic iron abundance of 6.83±0.02 for TrES-1 (on the $\log n$(H)=12.00 scale), as compared to the solar value of 7.44 (e.g Bellot Rubio & Borrero 2002). Note that the abundance error is just an internal error from the fits to several Fe I line profiles. A standard value for the microturbulence of 0.5 km s^{-1} and a radial-tangential macro-turbulence of 2.0 km s^{-1} were adopted. As noted before, $v \sin i$ was refined during the fitting process to be 2.8±0.2 km s^{-1} . The differential logarithmic iron abundance of approximately –0.6 (with $\log n(\mathrm{Fe}_\odot)$=7.44) is therefore not compatible with the assumption of solar metallicity in the preliminary analysis of Alonso et al. (2004). Finally, we emphasize that having a metallicity less than solar is apparently unusual for stars that have extrasolar planets (Santos et al. 2004).

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ERRATUM FOR IBVS 5566

See erratum in IBVS 5648.

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V393 Hya: A NOVA-LIKE WITH VARIABLE EMISSION

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The Edinburgh-Cape Blue Object Survey (Kilkenny et al. 1997) classified the object EC 10578-2935 as a possible cataclysmic variable (CV), a classification later confirmed by Sefako et al. (1999). These classifications were based on low resolution spectrograms (100 Å/mm dispersion, corresponding to 4 Å resolution), and the colors $B-V=-0.01$ and $U-B=-0.83$, which placed the object just below the black body line in $(U-B, B-V)$, consistent with the weak Hβ and Hγ emission seen in the spectrograms. These facts have resulted in the GCVS classification NL: (possible nova-like) under the name V393 Hya (Kazarovets et al. 2003).

We have obtained the first high-resolution (R$\sim$48000) spectrum of EC 10578-2935, using FEROS at the ESO/MPI-2.20m telescope at La Silla, Chile on 2004-01-13 (HJD 2453018.84285), during technical tests. Standard data reduction was performed with MIDAS including bias and flatfield correction, order extraction and wavelength calibration. Finally, a crude flux calibration was performed using a standard star taken several hours earlier. The spectra have a FWHM resolution of 0.15Å and cover the range 3800–9000Å. The S/N in the spectrum is only around 10 over most of the spectral range.

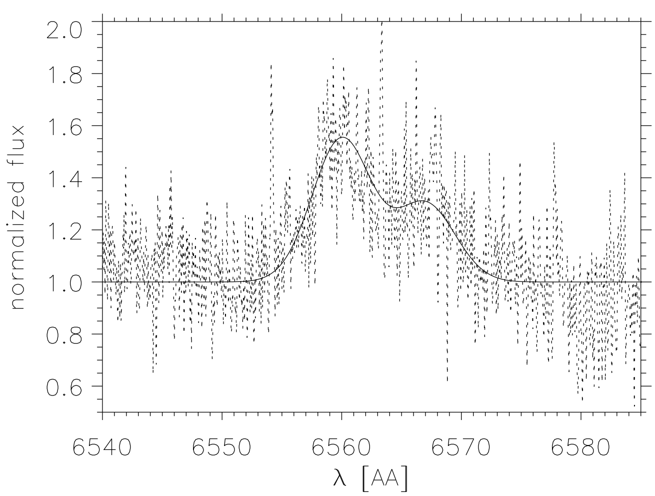

Figure 1. The region around Hα, with a two-gaussian fit to the profile.

The spectrum is essentially flat and featureless, the only exception being weak Hα in emission, as shown in Fig. 1.

The fit in Fig. 1 is a two-gaussian fit, with the gaussians centered at 6560.0 Å and 6567.0 Å respectively. The width of both profiles is 3.5 Å and we measure FWZI $\approx$ 16 Å, resulting in radial velocities of 160 km/s and 740 km/s respectively. These low values indicate that the system is seen at low inclination, with the typical double profile of the accretion disc barely resolved at our high spectral resolution.

Chen et al. (2001) found all Balmer lines in emission, although weak, plus He II and N III/C III. They estimate FWZI $\sim$ 20 Å for the Balmer lines. Our spectrum is completely flat and featureless at all these positions, which partly is due to our low S/N. We establish the equivalent width for Hα as $W(\mathrm{H}\alpha) = -18$ Å. For the other Balmer lines as well as for He II and the N III/C III blend we can only give upper limits to the equivalent widths, assuming the lines have the same shape as Hα. We derive $W < 14$ Å for these lines.

The system seem to show variable emission when comparing our findings with the literature. Also Chen et al. (2001) find that the strength of the Balmer lines changed between their 1990 and 1992 data sets.

We find that the continuum fits a power law of the type $\lambda^{-2.7}$, consistent with a hot accretion disk, as found e.g. for old novae (Schmidtobreick et al., 2004). Together with the weakness of the emission lines we conclude that V393 Hya is a cataclysmic variable of nova-like subtype, showing a hot accretion disc. The unfortunately rather low inclination under which V393 Hya is seen, makes it an unpromising object for time resolved follow–up studies of the accretion disc.

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COMMISSIONS 27 AND 42 OF THE IAU
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THE GEOS RR Lyr SURVEY

Maxima of RR Lyr stars observed by the automated telescope TAROT

(GEOS Circular RR 21)

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A GEOS program (`http://www.upv.es/geos/`) (Boninsegna et al., 2002) of automated observations of RR Lyr stars has started in January 2004, using the telescope TAROT (`http://tarot.obs-hp.fr`) located in Calern Observatory (Observatoire de la Côte d'Azur, Nice University, France). The aim of this survey is to monitor maxima of light of RR Lyr stars in order to feed the GEOS RR Lyr web database (`http://webast.ast.obs-mip.fr/people/leborgne/dbRR`). This is a legacy project for the study of period variations of RR Lyr stars.

TAROT is a 25cm automatic telescope designed for observations of gamma ray burst (GRB) afterglows in the visible. It is automatically triggered by gamma ray satellites (Boër et al., 2001, Bringer et al., 1999). While waiting for GRB triggering, TAROT may be used for other photometric programs: the GEOS RR Lyr survey is one of them. TAROT images are obtained by a 2048×2048 Marconi 42-40 thin back illuminated CCD. Field of view is $1\overset{\circ}{.}86\times1\overset{\circ}{.}86$. Data reduction, from bias subtraction and flatfielding to photometry using SExtractor, is performed automatically.

We present here the first list of light maxima of RR Lyrae stars observed with no filter between January and June 2004 (Table 1). Maxima are determined by fitting a polynomial function on the data points. The uncertainties on individual maxima are estimated from the data sampling of each maximum. The nominal sampling (twin measures within 1 minute in every 10 minutes at foreseen maximum time) may be altered by local events (weather or telescope operation). This results uncertainties from 0.002 to 0.010 day. For a well observed star, the mean uncertainty on maxima is about 0.003 day (4.3 minutes). All $O-C$'s are computed with the GCVS elements (Kholopov et al. 1985) and are displayed in table 2 in column "$O-C$ (1)". "$O-C$ (2)" are computed with elements which allow more precise predictions for scheduling observations from the BAV web site `http://www.var-mo.de` when available.

Table 1: maxima of RR Lyrae stars

Variable	Maximum HJD 24...	$O-C$ (1) (days)	E (1)	$O-C$ (2) (days)	E (2)	ref (2)
SW And	53040.306±0.005	0.166	78926	−0.005	10134	1
SW And	53044.293±0.005	0.173	78935	0.001	10143	1
SW And	53047.384±0.002	0.168	78942	−0.003	10150	1
XX And	53042.449±0.003	0.210	19308	0.006	2582	1
XX And	53045.341±0.004	0.211	19312	0.007	2586	1
X Ari	53054.333±0.003	0.266	23759	0.014	2901	1
TZ Aur	53034.598±0.005	0.018	84591			
RS Boo	53043.496±0.006	0.005	29875			
RS Boo	53049.534±0.002	0.005	29891			
RS Boo	53050.666±0.003	0.005	29893			
RS Boo	53132.541±0.002	−0.002	30110			
RS Boo	53175.558±0.005	−0.002	30225			
ST Boo	53122.562±0.003	0.097	54542	0.015	2936	2
ST Boo	53132.516±0.002	0.095	54558	0.012	2952	2
TW Boo	53037.546±0.010	−0.044	49122	−0.006	8524	2
TW Boo	53039.673±0.003	−0.046	49126	−0.009	8528	2
TW Boo	53044.465±0.007	−0.044	49135	−0.007	8537	2
TW Boo	53047.666±0.002	−0.037	49141	0.000	8543	2
SS Cnc	53034.302±0.005	0.040	81548	−0.007	81548	1
TT Cnc	53046.343±0.004	0.087	23253	0.015	6039	2
TT Cnc	53047.435±0.003	0.052	23255	−0.020	6041	2
TT Cnc	53048.596±0.005	0.086	23257	0.015	6043	2
W CVn	53038.519±0.005	−0.130	57337	0.000	9140	2
W CVn	53039.634±0.005	−0.118	57339	0.011	9142	2
W CVn	53048.461±0.010	−0.120	57355	0.010	9158	2
W CVn	53050.664±0.002	−0.124	57359	0.006	9162	2
W CVn	53055.624±0.005	−0.129	57368	0.000	9171	2
UZ CVn	53162.465±0.010	0.230	38314	−0.023	2690	2
V363 Cas	53047.402±0.010	−0.073	30931	−0.013	6211	2
ST Com	53132.548±0.002	−0.034	16543	−0.002	13391	2
ST Com	53147.519±0.005	−0.037	16568	−0.004	13416	2
TV CrB	53119.505±0.003	0.016	36778	−0.009	4993	2
UY Cyg	53166.568±0.003	0.051	54811	0.005	25193	2
DX Del	53181.507±0.004	0.053	29229	0.000	29229	1
XZ Dra	53038.304±0.005	−0.074	23316	−0.024	15043	2
XZ Dra	53041.644±0.005	−0.070	23323	−0.020	15049	2
XZ Dra	53042.602±0.010	−0.065	23325	−0.015	15052	2
XZ Dra	53043.546±0.003	−0.074	23327	−0.024	15054	2
GI Gem	53034.650±0.010	0.075	52365	0.001	52365	1
TW Her	53181.566±0.004	−0.008	79170			
VX Her	53168.554±0.006	0.079	68994	−0.023	3189	1
AR Her	53044.608±0.003	−0.159	24659	0.024	6696	2

ref.: 1 `http://www.var-mo.de/rr-lyrae-sektion.htm`
2 `http://www.var-mo.de/st-daten.htm`

Table 1 (cont.): maxima of RR Lyrae stars

Variable	Maximum HJD 24...	$O-C$ (1) (days)	E (1)	$O-C$ (2) (days)	E (2)	ref (2)
RR Leo	53046.346±0.003	0.059	21554	0.017	4005	1
RR Leo	53047.699±0.003	0.055	21557	0.013	4008	1
RR Leo	53048.604±0.002	0.055	21559	0.013	4010	1
RR Leo	53049.515±0.003	0.061	21561	0.019	4012	1
RR Leo	53050.420±0.005	0.061	21563	0.019	4014	1
RR Leo	53051.322±0.002	0.058	21565	0.017	4016	1
RR Leo	53101.540±0.004	0.061	21676	0.019	4127	1
SS Leo	53050.565±0.003	−0.027	17992			
TT Lyn	53048.520±0.010	−0.019	27446			
CN Lyr	53131.553±0.010	0.020	21015			
CN Lyr	53145.536±0.006	0.016	21049			
CN Lyr	53154.584±0.010	0.013	21071			
CN Lyr	53168.572±0.004	0.014	21105			
AR Per	53040.552±0.002	0.050	60635	0.003	3015	1
AR Per	53041.401±0.002	0.048	60638	0.001	3017	1
AR Per	53043.529±0.002	0.048	60643	0.002	3022	1
AR Per	53044.379±0.002	0.047	60645	0.000	3024	1
AR Per	53046.508±0.002	0.048	60650	0.002	3029	1
AR Per	53047.365±0.004	0.054	60652	0.008	3030	1
AR Per	53101.409±0.004	0.053	60779	0.007	3158	1
AN Ser	53089.562±0.001	−0.005	73516			
AN Ser	53123.498±0.002	−0.004	73581			
RV UMa	53039.643±0.002	0.091	17015	0.003	3797	2
RV UMa	53040.586±0.004	0.098	17017	0.010	3799	2
RV UMa	53041.508±0.002	0.084	17019	−0.004	3801	2
RV UMa	53042.458±0.002	0.098	17021	0.010	3803	2
RV UMa	53047.601±0.002	0.092	17032	0.004	3814	2
TU UMa	53039.403±0.005	−0.034	18305	0.016	18305	1
TU UMa	53049.440±0.010	−0.035	18323	0.015	18323	1
TU UMa	53050.549±0.003	−0.041	18325	0.009	18325	1
TU UMa	53054.453±0.002	−0.041	18332	0.009	18332	1
BN Vul	53155.518±0.010	0.065	12834	0.010	2991	1

ref.: 1 `http://www.var-mo.de/rr-lyrae-sektion.htm`
2 `http://www.var-mo.de/st-daten.htm`

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NEW SU UMa-TYPE DWARF NOVA V344 Pav

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Maza & Hamuy (1990) reported the discovery of a dwarf nova in outburst at $m_{\rm pg} = 14.5$ in Pavo, which was designated as V344 Pav in Kazarovets et al. (1993). Mason & Howell (2003) reported a quiescent spectrum of V344 Pav, which exhibits typical features of dwarf nova in quiescence. Its quiescent magnitude was estimated to be $\lesssim 20$ mag. According to Mason & Howell (2003), the object was $V = 19.4$ at the time of their spectroscopic observation. Based on a relatively large amplitude of outburst, they commented that V344 Pav is likely a WZ Sge-type dwarf nova, or a TOAD (Tremendous Outburst Amplitude Dwarf novae; Howell et al. 1995).

An outburst of V344 Pav was reported to the VSNET on JD 2453233.04 at a visual magnitude of 14.4. We then initiated CCD time-series photometric observations at Universidad de Concepción. We used a Meade 30-cm Schmidt-Cassegrain telescope and an unfiltered ST-7XMEI camera. After correcting for the standard de-biasing and flat fielding, we performed the PSF photometry for the images. The differential magnitudes of the variable were measured against UCAC2 04225816 (11.42 mag in the UCAC system), whose constancy during the run was confirmed by UCAC2 04225753 (12.96 mag in the UCAC system). The log of observations is shown in table 1. Heliocentric corrections were applied before the period analysis.

Table 1. Observation log.

$T_{\rm start}$ (HJD)	ΔT (hr)	mag.	N
2453235.5377	2.08	3.996 ± 0.005	230
2453236.5829	6.09	4.307 ± 0.003	673
2453237.5355	4.86	4.902 ± 0.008	535
2453238.5337	3.92	6.498 ± 0.027	438
2453239.5339	3.57	7.235 ± 0.046	391
2453240.5290	1.84	7.432 ± 0.078	203
2453241.5270	1.71	7.341 ± 0.076	183
2453242.5263	0.86	7.614 ± 0.106	98
2453250.5350	1.32	7.943 ± 0.191	92
2453256.5259	1.45	7.890 ± 0.093	162

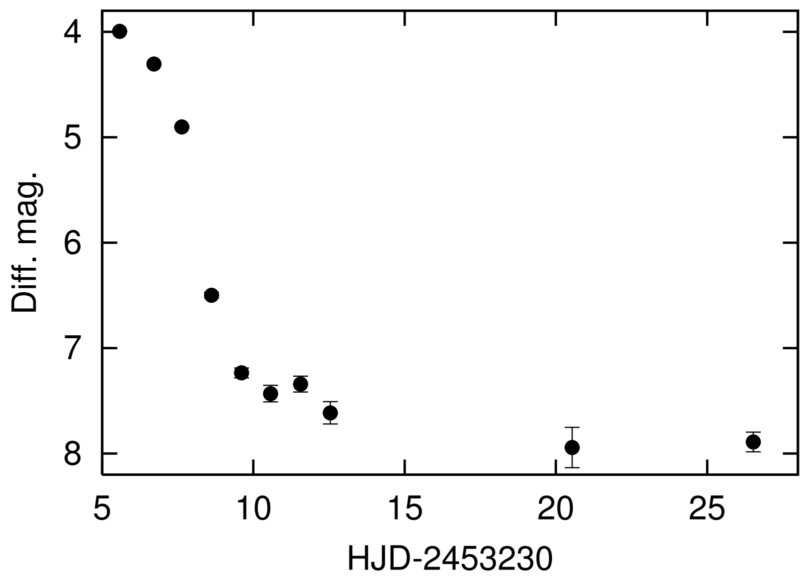

Figure 1. The overall light curve of the superoutburst of V344 Pav in August 2004. The abscissa and ordinate denote the time in HJD and the differential magnitude against a comparison star UCAC2 04225816 (11.42 mag in the UCAC system), respectively.

Figure 1 shows the overall light curve during the outburst. The object was gradually fading with a rate of 0.28 mag d^{-1} for the first two days, then entered a rapid fading phase on JD 2453237. After the rapid fading, the object returned to a quiescent level within 10 days. In the last two observations, the differential magnitudes are ~ 7.9 mag, which indicates that the quiescent magnitude is around 19.3 mag if we use the UCAC2 magnitude of the comparison star (11.42 mag).

Enlarged light curves are shown in Figure 2. Our observation clearly detects repetitive humps having amplitudes of 0.15 mag during the outburst, as can be seen in Figure 2. We performed a period analysis with the PDM method using the light curve between JD 2453235 and 2453237 (Stellingwerf 1978). Figure 3 is the resultant frequency–Θ diagram. The best period is calculated to be 0.079607 ± 0.000082 d. Figure 4 shows phase-averaged profiles of the humps on JD 2453235, 2453236, and 2453237. As can be seen from this figure, humps appeared even in JD 2453237, during the rapid fading stage. Secondary maxima appear in the hump profiles around the phase 0.4–0.5 in JD 2453235 and 2453236.

Although the observed duration of the outburst is short (3 d), features of the overall light curve and the humps resemble those of superoutbursts in SU UMa-type dwarf novae (cf. Warner 1985). We hence conclude that V344 Pav is an SU UMa type dwarf nova having a superhump period of 0.079607 ± 0.000082 d. It is possible that, at the time of the outburst detection, it had already been in a late phase of superoutburst. This is consistent with the presence of the secondary maximum in superhump profiles (Figure 4), since it generally appears in a late superoutburst phase. The outburst amplitude is > 3.9 mag, and probably ~ 5 mag if one assumes a typical properties of superoutburst, that is, a fading rate of ~ 0.1 mag d^{-1} and a duration of about two weeks (Warner 1985).

The superhump period of V344 Pav is a typical one for ordinary SU UMa stars, rather than WZ Sge-type stars having very short periods, except for RZ Leo (Ishioka et al.

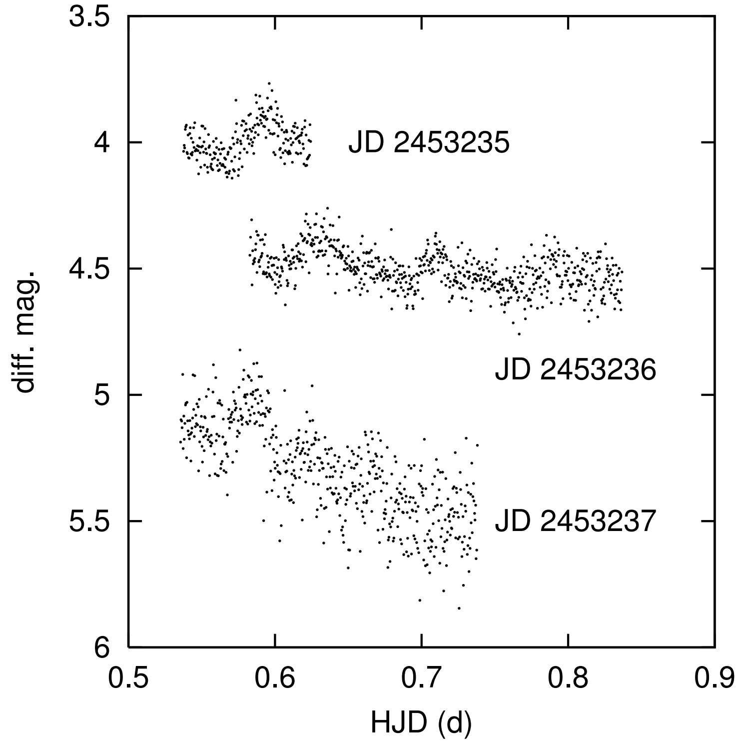

Figure 2. Enlarged light curves during the superoutburst of V344 Pav. The magnitude scales of JD 2453236 and 2453237 are shifted by +0.2 and +0.4 mag, respectively.

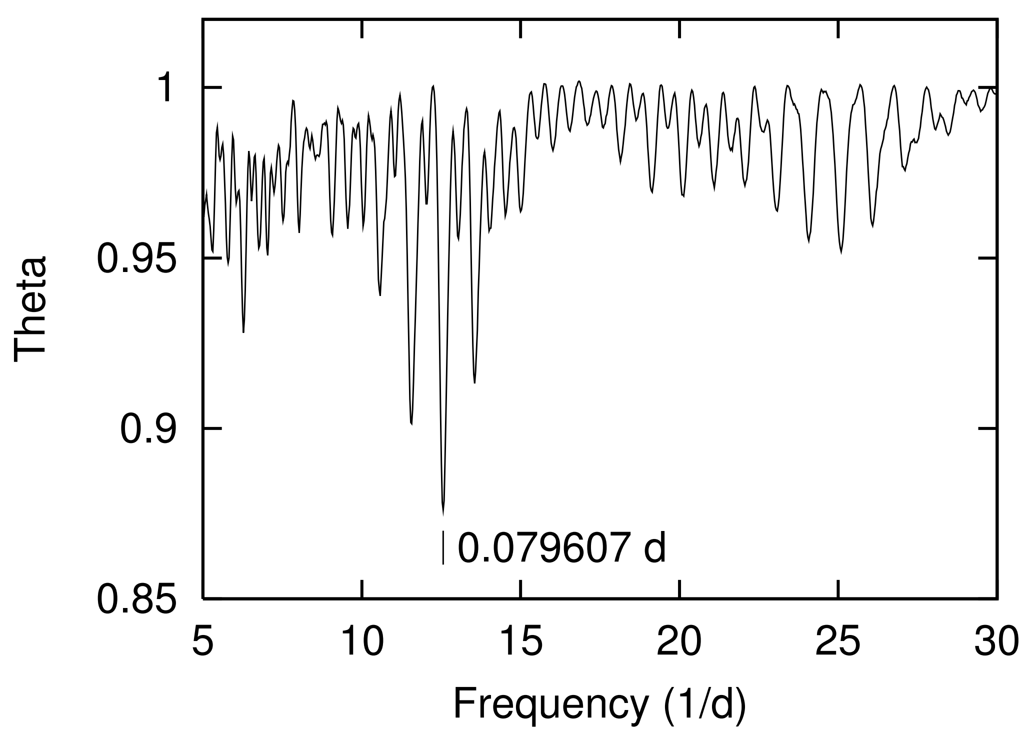

Figure 3. Frequency–Θ diagram calculated with the PDM method for superhumps in V344 Pav.

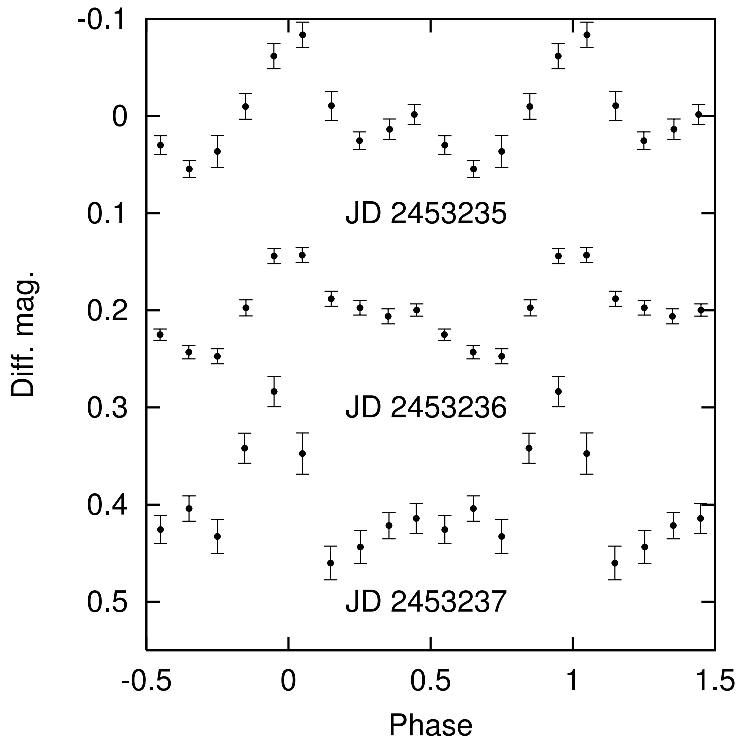

Figure 4. Average superhump profiles. The magnitude scales of JD 2453236 and 2453237 are shifted by +0.2 and +0.4 mag, respectively.

2001). The ordinary SU UMa-type nature for V344 Pav is also supported by its relatively high frequency of outbursts. According to Mason & Howell (2003), outbursts of V344 Pav are recorded in September 1983 ($m_{\rm pg} = 14.5$), March 1984 ($m_{\rm pg} = 16$), July 1990 ($m_{\rm pg} = 14.5$), September 1999 ($m_{\rm vis} = 14.3$), July and September 2000 ($m_{\rm vis} = 14.6$ and 14.4), and May 2001 ($m_{\rm vis} = 14.3$). In the VSNET data base, we find an additional outburst records in September 2003 ($m_{\rm vis} = 14.4$). In conjunction with the superoutburst in this paper (August 2004; $m_{\rm vis} = 14.5$), the supercycle is probably 1–2 years, much shorter than those of WZ Sge-type stars ($\gtrsim 10$ years). The faint outburst in March 1984 may be a normal outburst, which implies that a number of normal outbursts have been overlooked.

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NEW ECLIPSING BINARIES FOUND IN THE NSVS DATABASE I.

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The variability of the stars listed in this study was found in the public data release from the Northern Sky Variablity Survey (NSVS; Wozniak et al., 2004). Using the SQL interface available from the Skydot website (`http://skydot.lanl.gov/nsvs/nsvs.php`), stars were selected on the basis of a number of statistical criteria. The stars needed to have at least 100 data points, and a significantly larger standard deviation compared to the average value for their magnitude. It was also required that the mean of squared successive magnitude differences for a star was larger than about 30% of the standard deviation, thus excluding long period variables. Finally, the skewness calculated from a star's magnitudes had to be positive, favouring stars spending more time at maximum than at minimum. Standard flagged data and data with the APINCOMPL mask set (Wozniak et al., 2004) were not taken into account during these calculations. Because of obvious limitations of the available data, this study does not claim to give an exhaustive list of eclipsing binaries in the areas searched. Most of the stars in the current paper were in fact found during a search for Cepheids along the Northern Milky Way (Wils and Greaves, 2004).

ASAS-3 (Pojmanski, 2002) and NSVS data have been combined to prepare this first list with elements for 100 new eclipsing binaries.

The method of bisected chords was used to determine times of minima. The accuracy depends on the quantity and quality of the observations. Elements were found with AVE (Barberá, 1999) and a Microsoft Excel period search utility.

Unfiltered NSVS ROTSE1 magnitudes were shifted to match the ASAS-3 V magnitude of the stars. In all cases but one (GSC 4835 1947) the amplitude of the eclipses were the same for both datasets so the combination was successful. For stars North of +28 degrees, where no ASAS observations exist, the original ROTSE1 magnitudes are given.

Table 1 shows the list of variables. The first column gives the GSC designation. The following columns give another identifier; the brightness range of the variable (V = ASAS-3 V magnitudes; *= ROTSE1 magnitudes), with the magnitude of secondary eclipse between brackets; the epoch of minimum light derived from all the data available; the period; the variability class and the spectral type with a note to the spectral type source.

Star Name		Magnitude range	Epoch	Period	Type	Spectral type
GSC ID	Other ID		(HJD2440000+)	(days)		
0140 0964	AC 0043437	11.92– 12.8 (12.65)V	11525.891	0.298305	EW/KW	
0140 1869	AC 0042265	12.89– 13.6 (13.6)V	11508.815	1.45065	EA	
0143 0226*	HD 252984	10.13– 10.73(10.63)V	12946.750	4.21618	EA	A0 (33)
0145 2357	AC 0257934	12.28– 12.83(12.80)V	11498.710	10.0209	EA	
0155 1091	HD 261744	10.89– 11.41(11.39)V	12714.509	2.95379	EA	F8 (33)
0155 2294	HD 261717	10.35– 10.67(10.63)V	11566.624	1.85270	EA	A0V (51)
0158 0541	HD 260764	10.62–11.15:(10.82)V	11604.760	3.06895	EA	A2 (33)
0159 0812	HD 261685	11.27– 11.72(11.44)V	12521.868	2.88420	EA	A (33)
0159 1018	HD 261449	10.31– 10.59(10.57)V	11549.733	1.41626	EA	F8 (33)
0160 1934	HD 264769	10.85– 11.17(11.15)V	11465.840	2.13583	EA	B (33)
0170 1717*	AC 0063381	10.90– 11.17(11.16)V	11522.719	0.361883	EW	
0410 2795	AC 0345491	10.89– 11.49(11.12)V	12775.769	0.490383	EB	
0437 0438	AC 0151782	12.54– 13.37(13.32)V	12760.797	2.14220	EA	
0441 0916	AC 0151695	12.75– 14.0 (12.77:)V	11450.710	3.3749	EA	
0448 0415*		12.41– 13.2 (13.2)V	12725.340	99.4022	EA	
0469 0914		12.45– 12.95 (12.8)V	12196.500	72.35	EB	
0471 0860*	AC 0157271	10.87– 11.28(11.23)V	11320.786	0.345897	EW	
0473 3466	AC 0160195	11.93– 12.6:(12.5:)V	12853.755	2.1085	EA	
0485 0658		13.15– 13.7 (13.7)V	11420.616	0.290570	EW/KW	
0493 0801	BD+6 4353	10.42– 11.30(10.62)V	12524.606	0.986783	EA	
0613 1099	AC 0208368	11.35– 12.00(11.95)V	12873.909	0.336338	EW	
0646 0946	BD+13 453	10.28– 10.55(10.54)V	11382.902	0.282336	EW/KW	
0684 1316*	SAO 112139	10.32– 10.55(10.53)V	11594.630	0.377198	EW/KW	K0 (24)
0714 0096	BD+9 932	10.40– 10.84(10.62)V	12751.489	0.498858	EB	F0 (33)
0723 0980	HD 247317	9.97 – 10.42(10.31)V	11567.838	1.78018	EA	F2 (33)
0724 0973	AC 0479701	12.10– 12.77(12.35)V	11504.970	9.7857	EA	
0748 0686*	HD 267307	10.87– 11.50(11.38)V	12714.524	2.087092	EA	A5,A2 (53)
0748 2137	AC 0269265	11.56– 12.63 (11.7)V	12995.698	1.62398	EA	
0748 2423	HD 266430	9.63 – 9.97 (9.93)V	12761.545	4.00951	EA	A0 (33)
1040 0399	HD 178215	10.34– 11.00(10.48)V	11332.759	1.27428	EA	A0 (33)
1042 2191	HD 182314	9.14 – 9.49 (9.45)V	12812.702	0.423796	EW:	F5 (24)
1045 0882	HD 180244	10.34– 10.92(10.8:)V	11475.666	6.8855	EA	A2 (33)
1045 1028	AC 0386762	11.46– 12.2:(12.10)V	12403.733	0.3348417	EW	
1077 0828	HD 192169	8.78 – 9.34 (9.30)V	12879.640	1.705523	EA	F8 (24)
1113 0877	BD+12 4581	9.15 – 9.35 (9.28)V	12816.827	0.486707	EB	F0 (28)
1294 1710*	HD 285166	10.86– 11.48(11.37)V	12645.558	12.8075	EA	F8 (9)
1305 1430	AC 0654855	10.90– 11.20(11.20)V	11467.823	0.2955252	EW/KW	
1318 0042	ALS 25	11.12– 11.48 (11.4)V	12970.180	13.6435	EB	OBe (34)(25)
1322 0294	AC 0672161	11.03– 11.65(11.64)V	11521.695	0.287842	EW/KW	
1335 1907*	HD 265879	10.77– 11.20(11.06)V	11548.730	3.47041	EA	A5 (33)
1577 0974*	HD 348698	11.45– 12.05(12.01)V	11442.689	7.14615	EA	G0 (9)
1578 0728	HD 348901	10.60– 10.92(10.98)V	11403.882	4.59618	EA	F2 (9)
1582 0100	AC 0765199	11.46– 12.16(11.84)V	12747.884	5.5598	EA	
1588 0632*		12.80–13.84:(13.53:)V	11362.705	1.41924	EA	
1588 1802		12.38– 13.08(12.68)V	13130.770	7.6706	EA:	
1594 1043	HD 349787	10.84– 11.27(11.22)V	12724.899	2.11434	EA	G0 (9)
1619 0051	HD 350416	10.46– 10.76(10.65)V	11414.728	2.30593	EB	B8 (9)
1620 0599*	HD 354081	10.03– 10.32(10.22)V	11454.669	1.37599	EB	F2 (9)
1624 0493*	HD 350731	9.53 – 9.97 (9.93)V	12830.816	1.63514	EA	B9 (9)
1639 1340*	HD 352143	10.48– 10.77(10.71)V	11322.917	0.911325	EW:	F2 (9)
1641 1245	AC 0808903	11.89– 12.75(12.35)V	12879.688	7.2432	EA	
1643 1880	AC 0803127	12.44– 13.0:(12.6:)V	11332.770	0.73574	EA	
1761 1934	AC 0870736	10.38– 11.02(10.98)V	11525.671	0.299376	EW/KW	
1836 0131*		12.60– 14.5:(13.1:)V	11531.669	6.9098	EA	
1913 1513	AC 0926226	10.93– 11.33(11.07)V	11515.678	0.491507	EB/KW	
2157 0387*	HD 346723	10.39– 11.03(10.60)V	11467.654	1.551913	EB:	A0 (9)
2385 0341	HD 279999	10.11– 10.75(10.7:)*	11603.766	0.990715	EA	F0 (9)
2407 0767	HD 244128	10.75– 11.07(10.85:)*	11514.840	1.6192	EA	B5 (33)

Star Name GSC ID	Other ID	Magnitude range	Epoch (HJD2440000+)	Period (days)	Type	Spectral type
2409 0101	AC 0897066	12.95– 13.9:(13.25)*	11537.633	0.99282	EA	
2685 1186	HD 332325	11.37– 11.93(11.92)*	11358.748	0.62279	EW	F5 (9)
2695 1848	AC 1265359	12.21– 12.81(12.76)*	11325.791	0.93536	EA	
2704 1999*	BD+30 4459	10.70– 11.00(10.92)*	11341.764	0.610855	EB	
2711 0645*	AC 1270603	12.20– 12.61(12.59)*	11537.610	0.506738	EW	
2846 0404*	AC 1301247	10.71– 11.04(11.01)*	11494.882	0.387374	EW/KW	K0IV (50)
2863 0755	HD 275743	10.55– 10.82(10.70)*	11613.738	3.2554	EA	G5 (9)
2933 1972	AC 1448061	12.90– 13.65(13.65)*	11274.691	0.50488	EA	
3171 0761*		11.92– 12.62(12.31)*	11371.150	39.6	EB/GS:	
3181 0654*	ALS 11810	10.56– 11.1:(11.1:)*	11338.750	47.615	EA	OB (43)
3252 0981*	BD+47 116	9.89 –10.10 (10.05)*	11542.625	20.30	EB/GS:	
3314 0544*	BD+47 768	10.73– 11.25(11.21)*	11466.660	12.807	EA	
3319 0399		12.00– 12.55(12.05)*	11612.520	24.146	EA	
3429 0424*	AC 1604650	11.00– 11.80(11.70)*	11563.948	0.473522	EW	
3493 1324*	AC 1618923	11.10–11.45:(11.45:)*	11277.840	7.654	EA	
3574 1420*	BD+44 3531	10.28– 10.48(10.44)*	11421.720	22.425	EB/GS:	
3581 1856	AC 1647164	10.87– 11.27(11.21)*	11448.682	0.2785137	EW/KW	G5-8V (41)
3626 0107*	AC 1680379	10.40– 10.7:(10.6:)*	11401.100	19.9615	EA/GS:	
3633 2139*	AC 1677493	10.30–10.83:(10.69:)*	11441.210	17.915	EA/GS:	
3708 1325*	BD+56 704	10.92– 11.5:(11.38)*	11421.719	3.0240	EA	OB (43)
3712 1820	Lanning 54	11.15– 11.49(11.47)*	11421.708	0.960968	EW/KE	B5(V) (18)
3900 0615*	HD 238692	10.39– 11.09(10.70)*	11403.845	0.533529	EB	F3IV (49)
3950 0275	AC 1647107	10.75– 11.00(10.98)*	11461.908	0.242324	EW	
4021 0238*	ALS 6464	11.30– 11.80(11.73)*	11349.919	0.457606	EW/KE:	B2 (28)
4276 0398*	ALS 12480	10.76– 10.98(10.87)*	11364.751	3.8053	EA	OBe (25)
4280 1816*	ALS 13003	11.20– 11.48(11.48)*	11462.625	1.94145	EA/KE	OB (43)
4286 0049*	BD+64 1740	10.62– 10.92(10.86)*	11295.837	1.85197	EA	
4296 0222	BD+67 97	9.95 – 10.15(10.14)*	11608.823	13.651	EA	
4297 1664*		11.85– 12.39(12.28)*	11473.568	4.159	EA	
4338 0429	BD+72 167	9.78 –10.25(10.22:)*	11602.607	3.4572	EA	
4339 0250*		12.45– 13.01(13.01)*	11421.782	0.84040	EA	
4420 1984	AC 2045693	11.55–12.15 (12.12)*	11356.754	0.61927	EW	
4421 1217	AC 2047724	12.11– 12.89(12.75)*	11318.723	0.3472223	EW	
4436 1300*	AC 2053572	11.77– 12.12(12.07)*	11338.851	0.457033	EB/KE	
4527 0161	AC 1991853	10.94– 11.22(11.21)*	11525.793	0.619753	EA/RS:	
4614 1442*	AC 2102233	11.08– 12.00(11.34)*	11356.739	1.54912	EA/RS	
4650 1055*	AC 2093265	11.78– 12.28(12.23)*	12856.842	0.328692	EW	
4822 2853*	HD 052433	8.30 – 8.55 (8.52)V	12625.800	5.95575	EA	B9 (24)
4835 1947*	BD–2 2221	9.05:– 9.70:(9.48:)V	13057.664	0.637705	EB	A5 (28)
4854 0362*	HD 067093	8.84 – 9.18 (9.18)V	11927.725	4.33593	EA	A3/5mA7-F0 (5)
4902 1190*	BD–4 2739	9.96 –10.50(10.46)V	12705.725	1.43916	EA	
5146 0728*	PPM 708078	10.16–10.33(10.30)V	12437.759	0.523673	EB/KE:	

Sources of spectral type: (5) Houk and Swift, 1999. (9) Nesterov et al., 1995. (17) Buscombe, 1998. (18) Buscombe, 1999. (24) Ochsenbein, 1980. (25) Wackerling, 1970. (28) Kharchenko, 2001. (33) Cannon and Pickering, 1993. (34) Stephenson and Sanduleak, 1971. (41) Motch et al., 1997. (43) Hardorp et al., 1959-1965. (49) Bartaya, 1983. (50) Li and Hu, 1998. (51) Voroshilov et al., 1985. (53) Schmidt and Carruthers, 1993.

Notes on individual stars:

GSC 0143 0226 = Eccentric system. Visual companion (9.8 Vt; sp. K5)(Wright et al., 2003) at 5″.0 (Worley and Douglass, 1997)
GSC 0170 1717 = Slight O'Connell effect.
GSC 0448 0415 = Primary eclipse might be the secondary.
GSC 0471 0860 = Slight O'Connell effect.
GSC 0684 1316 = Changing O'Connell effect.
GSC 0748 0686 = Spectrum is for a blend (Schmidt and Carruthers, 1993). Spectrum G5

in Cannon and Pickering (1993) is not consistent with 2MASS and Tycho-2 colors.
GSC 1294 1710 = Eccentric system.
GSC 1335 1907 = Eccentric system.
GSC 1577 0974 = Eccentric system.
GSC 1588 0632 = Slightly eccentric.
GSC 1620 0599 = Visual binary. $A = 10^{\mathrm{m}}\!.7$; $B = 10^{\mathrm{m}}\!.9$ Vt. Sep. $0''\!.57$ (Fabricius et al., 2002).
GSC 1624 0493 = Eccentric system.
GSC 1639 1340 = Might be EB-type.
GSC 1836 0131 = Slightly eccentric system.
GSC 2157 0387 = Might be EA-type.
GSC 2704 1999 = O'Connell effect.
GSC 2711 0645 = O'Connell effect.
GSC 2846 0404 = Very strong O'Connell effect. Max II= 10.82. Possible T Tauri star (Li and Hu, 1998).
GSC 3171 0761 = H-alpha star (Kohoutek et al., 1997) and infrared source (Egan et al., 2003).
GSC 3181 0654 = Eccentric system. Primary eclipse might be the secondary.
GSC 3252 0981 = Visual binary. $A = 10.^{\mathrm{m}}\!.7$; $B = 11^{\mathrm{m}}\!.2$ Vt. Sep. $0''\!.66$ (Fabricius et al., 2002). Tycho-2 $B - V$ for the combined light is $1^{\mathrm{m}}\!.08$ (Hog et al., 2000).
GSC 3314 0544 = Eccentric system.
GSC 3429 0424 = Slight O'Connell effect.
GSC 3493 1324 = Slightly eccentric system.
GSC 3574 1420 = $B - V$ from Tycho-2= $0^{\mathrm{m}}\!.98$.
GSC 3626 0107 = $B - V$ from Tycho-2= $1^{\mathrm{m}}\!.26$.
GSC 3633 2139 = $B - V$ from Tycho-2= $1^{\mathrm{m}}\!.42$.
GSC 3708 1325 = Eccentric system.
GSC 3900 0615 = O'Connell effect. Max. II= 10.43.
GSC 4021 0238 = Might be EB/KE.
GSC 4276 0398 = Also possibly BE or WR-type.
GSC 4280 1816 = Primary eclipse might be the secondary.
GSC 4286 0049 = Eccentric system.
GSC 4297 1664 = Slightly eccentric system.
GSC 4339 0250 = Primary eclipse might be the secondary.
GSC 4436 1300 = O'Connell effect.
GSC 4614 1442 = RS period = orbital period.
GSC 4650 1055 = Slight O'Connell effect. Max. II= 11.81.
GSC 4822 2853 = Eccentric system.
GSC 4835 1947 = Data contaminated by nearby GSC 4835 2059. ASAS-3 data used is that of the smaller aperture reduction. NSVS amplitude reduced by the light contamination.
GSC 4854 0362 = Wils and Dvorak (2003) give a period of 2.16780 d. and suggest the real period might be double.
GSC 4902 1190 = Wils and Dvorak (2003) give a period of 0.71958 d. and suggest the real period might be double.
GSC 5146 0728 = Might be EW/KE.

Figure 1. Light curve of GSC 0143 0226 showing NSVS and ASAS-3 observations.

Figure 2. Light curve of GSC 0684 1316 showing NSVS and ASAS-3 observations.

Figure 3. Light curve of GSC 0714 0096 showing NSVS and ASAS-3 observations.

Figure 4. Light curve of GSC 2846 0404 showing NSVS observations.

Figure 5. Light curve of GSC 4614 1442 showing NSVS observations.

Acknowledgements: The authors want to thank Doug Welch for providing access to the NSVS database at McMaster University and John Greaves for his collaboration and suggestions. This research has made use of the SIMBAD and VizieR databases operated at the Centre de Donnes Astronomiques (Strasbourg) in France.

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ERRATUM FOR IBVS 5570

In the list of new eclipsers GSC 1294-1710 should be GSC 1294-0710.

S. Otero

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XX OPHIUCHI IN DEEP MINIMUM AFTER 37 YEARS

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The first spectrum of XX Ophiuchi (= HD 161114, SAO 141834, BD–6.4638), obtained by Mrs. Fleming in 1907 (see Fleming and Pickering 1908), showed the well marked emission line of Hβ. Annie Cannon in Henry Draper Catalogue classified the spectrum as Bep, so the star seemed to belong to the group of Be stars. However, substantial differences in the spectra were found by Merrill (1924), who noted a lot of emission lines of ionised iron (Fe II). Merrill described that the enhanced line spectrum is presented in greater purity than in any ordinary laboratory source, so since that time the star has been called *Iron Star*. In 1925, however, the absorption lines of the enhanced titanium spectrum were the dominant feature (Merrill 1926).

The optical variability of XX Oph was noted for the first time by Woods in 1921 (see Cannon 1922). Most of the time the brightness of XX Oph slowly varies around the mean value of $V = 9$ mag. As can be seen from the historical light curve of Prager (1940), constructed from the measurements on Harvard plates obtained from 1890 to 1939, XX Oph undergoes occasional one magnitude deep and one to three years long minima. Such an optical behaviour is well described in R Coronae Borealis stars. In spite of that, XX Oph does not belong to this group as no traces of carbon were observed in the spectra.

Lockwood et al. (1975) introduced a cool companion to the spectrum because the spectral energy distribution could be represented by the contributions of a B0III star and an M6III star. XX Oph has been considered to be a mass-exchanging binary star since Lockwood et al. (1975). This was confirmed by Evans et al. (1993), with a slight change of the spectral types of the components – B0V and M7III.

Interestingly, the optical variability does not seem to be correlated with the spectral variability. XX Oph underwent a deep and wide minimum between 1921 and 1922 but the spectrum remained unchanged. On the contrary, the strong absorption lines were discovered in 1925 during the constant phase at maximum (Merrill 1932).

Spectra of some O and B supergiants in the Magellanic Clouds show some similarities to XX Oph. These supergiants belong to LBV stars (Luminous Blue Variables). However, XX Oph is not so luminous because it is a giant.

Recently, XX Oph has been observed in a deep minimum after 37 years of the maximum brightness. These variations are presented in Figure 1.

Observations presented in this paper are of two kinds, CCD and visual. CCD observations consist of the HIPPARCOS data (Perryman et al. 1997) from March 1990

(JD 2447960) to March 1993 (JD 2449060), ROTSE (Wozniak et al. 2004) from May 1999 (JD 2451318) to October 1999 (JD 2451482), ASAS–3 (Pojmanski 2002) from February 2001 (JD 2451947) to October 2004 (JD 2453280), and ESA INTEGRAL Optical Monitoring Camera (OMC) from April 2003 (JD 2452753) to March 2004 (JD 2453077). Unfiltered ROTSE data were shifted by +0.5 mag to match the other measurements. Visual data were taken from the following organizations: AAVSO (USA), AFOEV (France), MEDUZA (Czech Republic and Slovakia) and HAA VSS (Hungary).

The light curve is plotted in Figure 1. Visual data obviously do not attain the precision of the CCD observations. However, when averaged and smoothed, visual observations are a useful tool to judge the long-term optical changes. In this case, I used 20-day bins.

Seven deep minima have been observed in XX Oph since 1890. Approximate timings derived from the historical light curve are given in Table 1. The brightness of XX Oph slowly varied from 8.3 to 9.3 mag between 1968 and March 2004, when the gradual fading by 0.2 mag per month started. It seems that the fading stopped on 2nd September 2004 and reached $V = 10.15$ mag. The star has never been in maximum for such a long time (see Table 1).

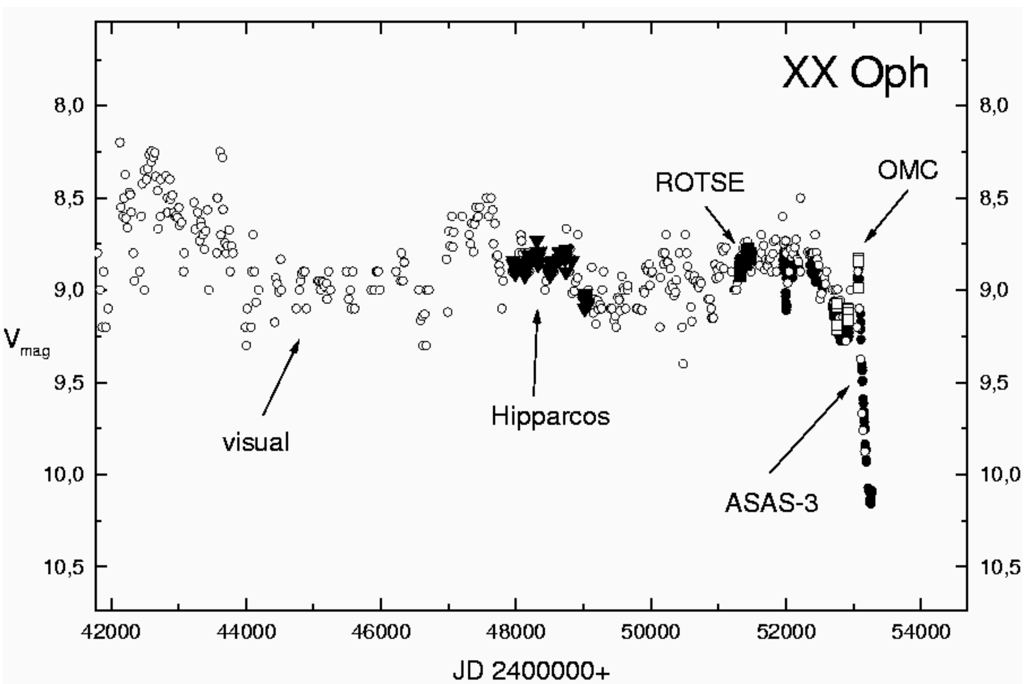

Figure 1. Light curve of XX Oph from 1974 to 2004. Filled circles represent CCD V-filtered observations of ASAS–3, filled squares are CCD unfiltered observations of ROTSE, the HIPPARCOS magnitudes are plotted as filled triangles, while INTEGRAL OMC V-filtered data are plotted as open squares. Averaged visual observations with 20-day bins of AAVSO, AFOEV, MEDUZA and HAA VSS are shown as open circles.

We are now experiencing the first possibility to observe XX Oph in minimum in modern era. Instrumentation and observing techniques have significantly improved in the last 37 years, thus we have an unique opportunity to understand XX Oph. The minima of brightness are probably caused by sudden weakening of the stellar wind (that is common in LBV stars, see Conti 1984) and this is our chance to see the stellar atmosphere. Mainly spectroscopic observations may reveal important information.

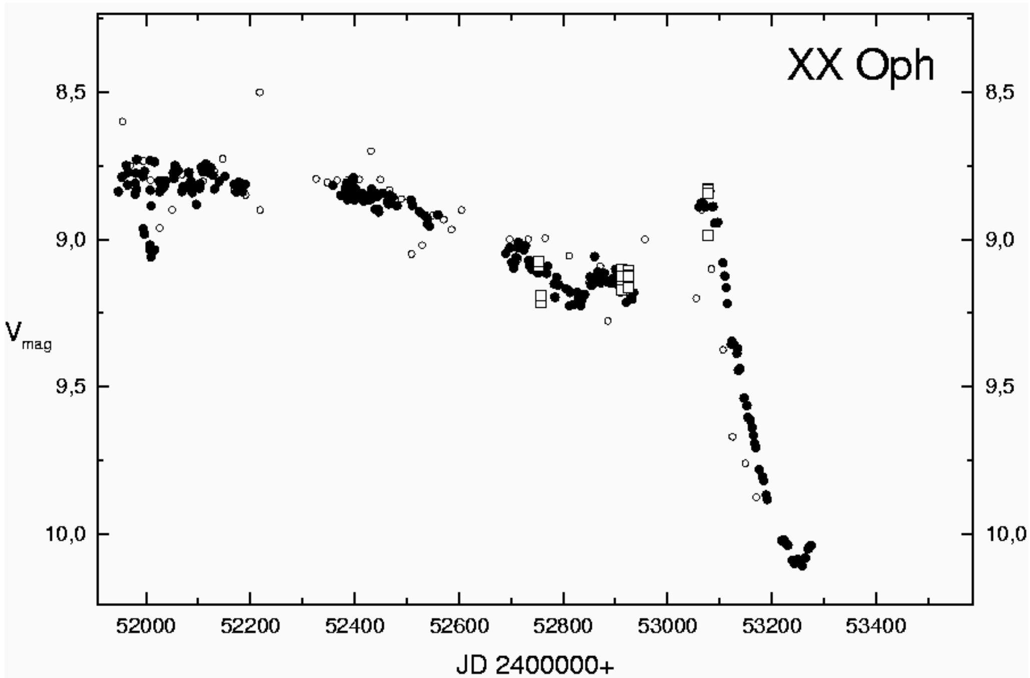

Figure 2. Detailed light curve of the past four years from 2001 to 2004. The symbols are the same as in Figure 1.

Table 1. Approximate timings of the deep minima of XX Oph.

$T_{\rm min}$ (year)	$T_{\rm min,i} - T_{\rm min,i-1}$ (years)	note	data source
1889	-		Prager 1940
1901	12		Prager 1940
1915	14		Prager 1940
1921-22	06	(double minimum)	Prager 1940
1931	09		Prager 1940
1947	16		Burnham 1977
1967	20		this paper
2004	37		this paper

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DISCOVERY OF A SHORT-PERIODIC PULSATING COMPONENT IN THE ALGOL-TYPE ECLIPSING BINARY SYSTEM TU Her

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As a part of international photometric survey projects to search for A-type pulsating components in eclipsing binary systems (Mkrtichian et al. 2002; Kim et al. 2003), we monitored several candidate targets during spring 2004 using telescopes across Europe and in the US. The instruments used were the 1.0 m telescope of the Universitätssternwarte Hoher List (OHL, Bonn, Germany), the 1.3 m Ritchey-Chrétien telescope of the Skinakas Observatory† (SKI, Crete) the 1.0 m telescope of the Mt. Lemmon Optical Astronomy Observatory (LOAO, USA) and the 0.4 m telescope of the Beersel Hills Observatory (BHO, Belgium). These telescopes were respectively equipped with the 2K×2K HoLiCam CCD (OHL), a 1K×1K CH360 CCD (SKI), a 2K×2K CCD (LOAO) and a 1.5K×1K ST-10 CCD (BHO).

The eclipsing binary system TU Her was monitored during 1 (partial) night at the Hoher List Observatory (filter Johnson V), three (partial) nights at Beersel Hills Observatory (filters Johnson V and B), 1 (full) night at the Skinakas Observatory (filter Johnson B) and two (partial) nights at Mt. Lemmon Observatory (filter Johnson B). In total we observed two eclipses and obtained out-of-eclipse data during the remaining four nights. The same comparison star C1 was used at all the sites. Additional comparison stars were observed when the CCD's fields were sufficiently large (larger than $8'.5\times8'.5$). From the first runs at BHO we suspected small-amplitude short-periodic oscillations in the light of TU Her (cf. Fig. 2, upper left panel). Follow-up observations to confirm these rapid variations were next performed at Skinakas and Mt. Lemmon in June and July 2004. These data are available upon request.

Standard aperture photometry was applied to all the frames to obtain differential instrumental magnitudes with respect to C1 as well as a few other comparison stars. Fig. 1 displays a sample CCD image of the field. Also indicated are the positions of the comparison and check stars. Several light curves acquired in the V and B passbands are shown in Figs. 2 and 3. From the out-of-eclipse light curves one can clearly distinguish short-periodic oscillations with a peak-to-peak amplitude of about 0.02 mag. A preliminary analysis of the data out-of-eclipse shows a main periodicity near 18 (± 0.2) c/d with a semi-amplitude of only 4-5 mmag.

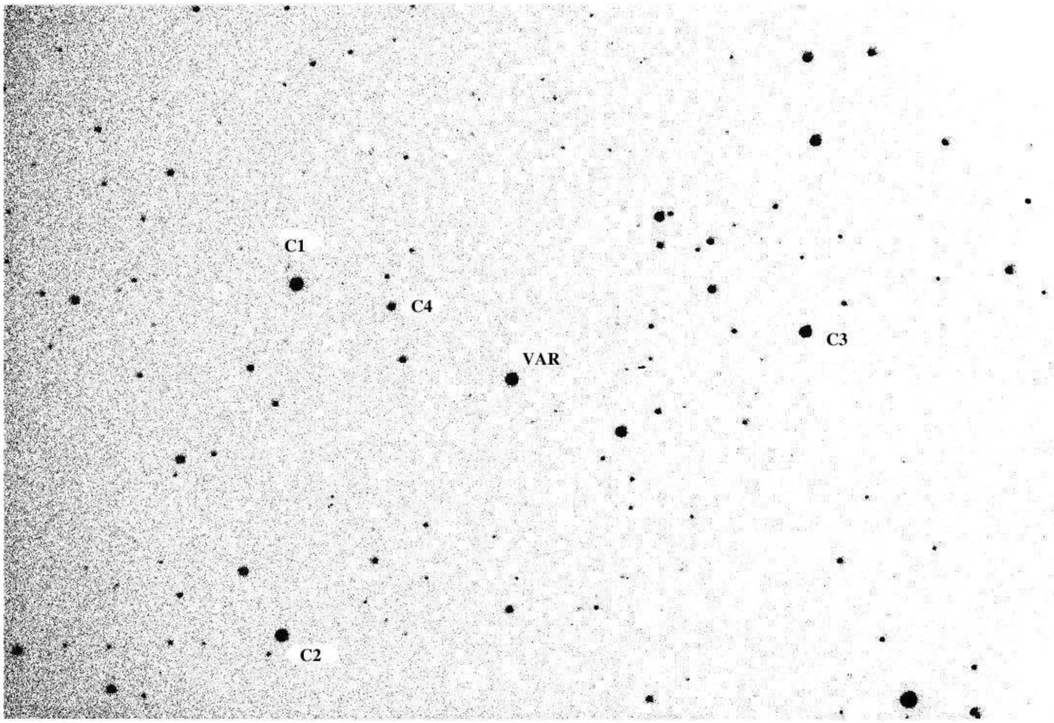

Figure 1. Field of the eclipsing binary TU Her (field size is $24' \times 16'$). The comparison (C1) and check stars (C2,C3,C4) are also marked. North is up and east is to the left.

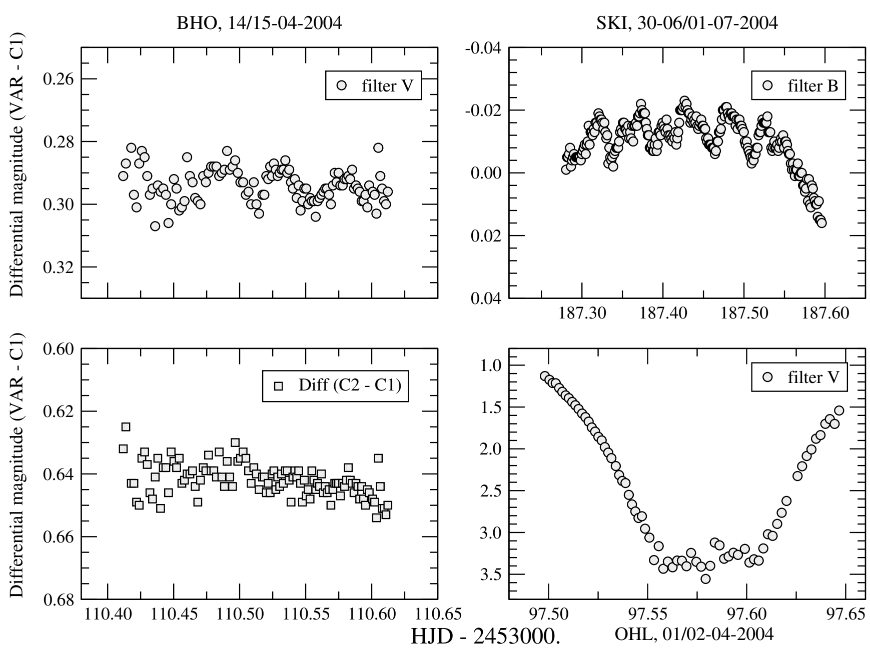

Figure 2. Light curves obtained at Beersel Hills, Skinakas and Hoher List observatories: differential magnitudes between the variable star TU Her and the main comparison star, ΔV(V$-$C1) resp. ΔB(V$-$C1). In one instance, the differential data of the check star ΔV(C2$-$C1) are displayed for comparison (lower left). On 01/02-04-2004, a total primary eclipse was observed (lower right).

Table 1. Photometric properties of target and comparison stars from the Tycho-2 catalogue (ESA 1997)

ID	Name/GSC	RA (J2000)	DEC (J2000)	V_T	$(B_T - V_T)$	Observatory
VAR	TU Her	$17^{\mathrm{h}}13^{\mathrm{m}}35^{\mathrm{s}}.37$	$+30^\circ42'36''.0$	$11^{\mathrm{m}}.153$	$0^{\mathrm{m}}.123$	all
C1	02591-00191	$17^{\mathrm{h}}13^{\mathrm{m}}58^{\mathrm{s}}.96$	$+30^\circ45'16''.3$	$10^{\mathrm{m}}.597$	$-0^{\mathrm{m}}.197$	all
C2	02591-00264	$17^{\mathrm{h}}14^{\mathrm{m}}03^{\mathrm{s}}.35$	$+30^\circ36'45''.9$	$11^{\mathrm{m}}.225$	$0^{\mathrm{m}}.852$	BHO; LOAO
C3	02591-00115	$17^{\mathrm{h}}13^{\mathrm{m}}01^{\mathrm{s}}.78$	$+30^\circ43'16''.0$	$11^{\mathrm{m}}.473$	$0^{\mathrm{m}}.522$	LOAO
C4	02591-00161	$17^{\mathrm{h}}13^{\mathrm{m}}48^{\mathrm{s}}.44$	$+30^\circ44'35''.5$	$(12^{\mathrm{m}}.9)$	–	OHL

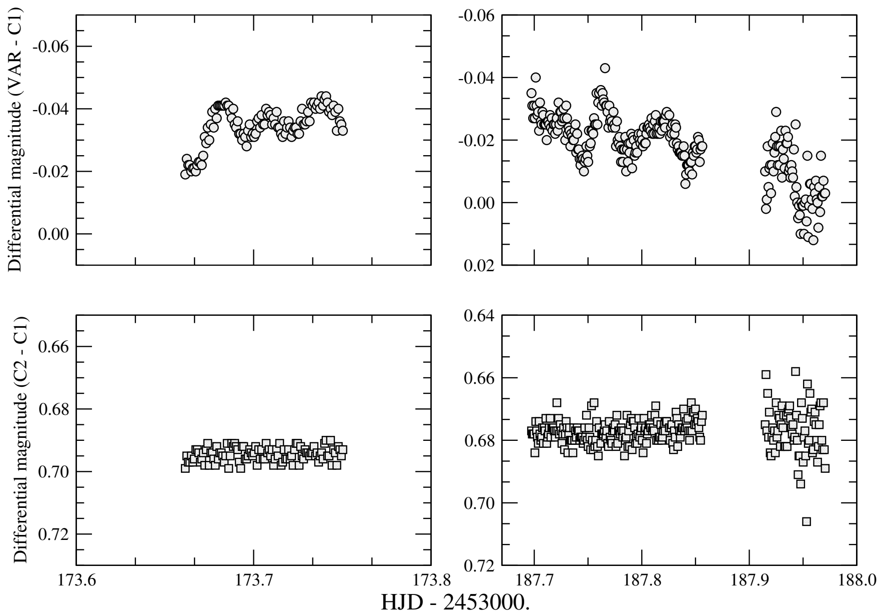

Figure 3. Two light curves obtained at Mt. Lemmon Observatory: differential magnitudes between the variable star TU Her and the main comparison star, $\Delta B(\mathrm{V}-\mathrm{C1})$. Differential data of the check star, $\Delta B(\mathrm{C2}-\mathrm{C1})$, are displayed in the lower panels for comparison.

Total eclipses were observed on two occasions: on the night of April 01/02, 2004 at OHL and on the night of July 28/29, 2004 at BHO (see also Fig. 4). These phenomena were used to compute two new times of mid-eclipse. TU Her, with a period of 2.2671 days in the GCVS catalogue (Kholopov et al. 1988), shows a rapidly decreasing orbital period (Shengbang 2000). Table 2 lists the new times and their residuals with respect to the quadratic ephemeris determined by Shengbang (2000) (cf. equ. 6). The increasing residuals indicate that the observed times (again) deviate from their expected values.

The new pulsating variable star is classified as of spectral type A5 (SIMBAD, CDS), but also F0 III/IV (Halbedel 1984). In view of the similarity between the characteristics of the shown light curves and those typical of a δ Scuti star (period, amplitude), the spectral type and the semi-detached binary configuration, we propose that TU Her is a new member of the group of mass-accreting pulsating components in Algol-type eclipsing

[†]The Skinakas Observatory is a collaborative project of the University of Crete, the Foundation for Research and Technology – Hellas, and the Max-Planck-Institut für Extraterrestrische Physik.

Table 2. Times and residuals for two new mid-eclipse events of TU Her

HJD ± error	Min.	Cycle Nr.	Predicted HJD	$(O-C)$
2453097.5800 ± 0.0008	I	6897	2453097.4651	0.1149
2453215.4615 ± 0.0005	I	6949	2453215.3429	0.1186

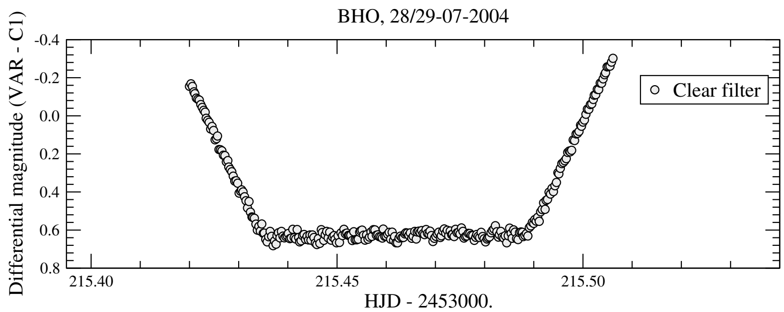

Figure 4. Light curve obtained at BHO showing a total eclipse of TU Her.

binary systems (oEA stars; cf. Table 3 in Mkrtichian et al. 2004). Thus the number of known oEA stars is presently thirteen, including the recent discoveries of four new oEA stars during this same year (Caton 2004; Kim et al. 2004a, 2004b).

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Mkrtichian, D.E., Kusakin, A. V., Gamarova, A. Yu. et al., 2002, ASP Conf. Ser. **256**, eds. C. Aerts, T. R. Bedding & J. Christensen-Dalsgaard, 259
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Shengbang, Q., 2000, *AJ*, **119**, 901

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NEW DWARF NOVAE ON MOSCOW PLATES III

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Institute of Astronomy, Russian Academy of Sciences, 48, Pyatnitskaya Str., Moscow 119017, Russia

Name of the object:
Antipin V79 (Var 79 Peg) = 1RXS J215434.4+355023

Equatorial coordinates:	**Equinox:**
R.A.= $21^{h}54^{m}33\overset{s}{.}66$ **DEC.=** $+35^{\circ}50'17\overset{''}{.}4$	2000

Observatory and telescope:
40-cm astrograph in Crimea

Detector:	Photoplate

Filter(s):	None

Comparison star(s):

α (J2000)	δ (J2000)	B_{pg}
$21^{h}54^{m}18\overset{s}{.}7$	$+35^{\circ}48'04''$	$14\overset{m}{.}01$
$21^{h}54^{m}35\overset{s}{.}6$	$+35^{\circ}49'16''$	$14\overset{m}{.}53$
$21^{h}54^{m}18\overset{s}{.}4$	$+35^{\circ}51'07''$	$14\overset{m}{.}86$
$21^{h}54^{m}21\overset{s}{.}1$	$+35^{\circ}52'49''$	$15\overset{m}{.}29$
$21^{h}54^{m}30\overset{s}{.}2$	$+35^{\circ}51'46''$	$15\overset{m}{.}61$
$21^{h}54^{m}34\overset{s}{.}2$	$+35^{\circ}51'50''$	$15\overset{m}{.}90$
$21^{h}54^{m}38\overset{s}{.}9$	$+35^{\circ}51'22''$	$16\overset{m}{.}70$
$21^{h}54^{m}37\overset{s}{.}4$	$+35^{\circ}50'43''$	$17\overset{m}{.}0$
$21^{h}54^{m}37\overset{s}{.}9$	$+35^{\circ}49'32''$	$17\overset{m}{.}1$
$21^{h}54^{m}32\overset{s}{.}5$	$+35^{\circ}50'14''$	$17\overset{m}{.}6$
$21^{h}54^{m}34\overset{s}{.}1$	$+35^{\circ}50'35''$	$18\overset{m}{.}1$

Transformed to a standard system:	$B_{\rm pg}$
Standard stars (field) used:	Calibrated using the photoelectric B-band standard sequence near Cyg X-2 (Basko *et al.*, 1976) and the blue magnitudes of neighboring stars from the GSC 2.2 catalogue.

Date(s) of the observation(s):
1974–1996

Availability of the data:
Upon request

Type of variability:	UG

Remarks:
We investigated Var 79 Peg on 440 plates of Moscow collection taken for the interval JD 2442278–50279 (mostly in JD2442278–47828). The finding chart is given in Fig. 1. The light curve (Fig. 2) shows two important features. First, two kinds of outbursts were found: the short-lasting ones and the longer ones. The long-lasting outbursts with flat maxima, resembling superoutbursts of SU UMa-type dwarf novae, are clearly seen in Fig. 3b and 3d. The outbursts are relatively frequent. Second, the amplitude of variability strongly changed during the interval of observation: the brightness of Var 79 in minimum smoothly increased in 1980–1982. The photographic magnitudes changed within $14\overset{m}{.}0$–$<18\overset{m}{.}1$ before 1980 and within $14\overset{m}{.}35$–$17\overset{m}{.}0$ after 1982. The only exception is the year 1987 when the star was fainter than $17\overset{m}{.}1$ on Moscow plates and appeared at $b=18\overset{m}{.}26$, as measured in the GSC 2.2 catalog, on a POSS II blue plate (the asterisk in Fig. 2). Furthermore, we propose to identify the new variable with the X-ray source 1RXS J215434.4+355023. The source is relatively hard, the ROSAT hardness ratios are HR1 = 1.00±0.13 and HR2 = 0.91±0.13 (Voges et al., 2000). All foregoing characteristics make Var 79 Peg a very interesting and important object for investigation. Further observations are encouraged.

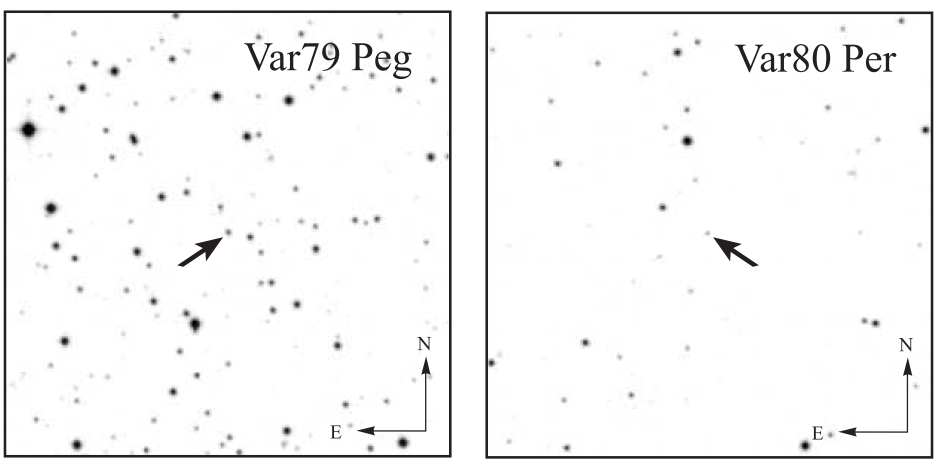

Figure 1. The finding charts, size 5' x 5'.

Name of the object:
Antipin V80 (Var 80 Per)

Equatorial coordinates:	Equinox:
R.A.= $2^{h}46^{m}02\overset{s}{.}33$ **DEC.**= $+34°55'08\overset{''}{.}4$	2000

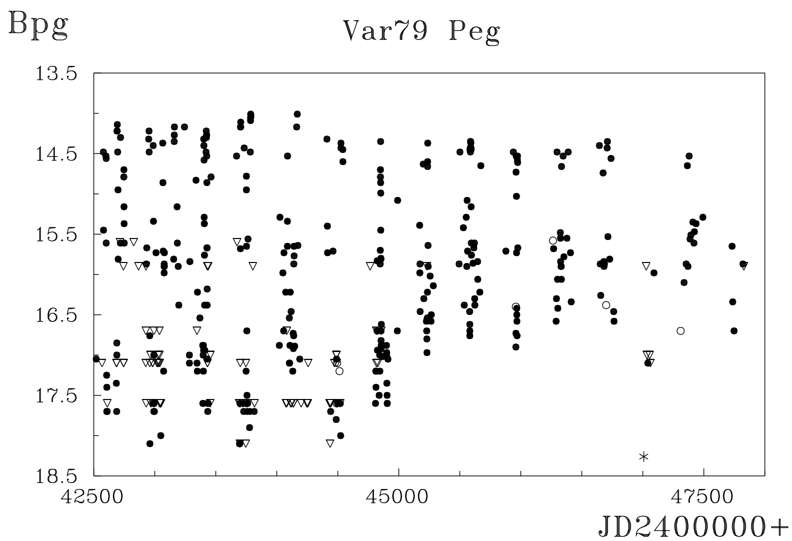

Figure 2. The photographic light curve of Var 79 Peg. Open circles: uncertain observations; open triangles: brighter limits; the asterisk: the GSC 2.2 estimate.

Observatory and telescope:
40-cm astrograph in Crimea

Detector:	Photoplate

Filter(s):	None

Comparison star(s):

α (J2000)	δ (J2000)	B_{pg}
$2^h45^m36\overset{s}{.}0$	$+34°56'13''$	$13\overset{m}{.}88$
$2^h45^m54\overset{s}{.}0$	$+35°00'05''$	$14\overset{m}{.}51$
$2^h45^m45\overset{s}{.}2$	$+34°56'35''$	$15\overset{m}{.}00$
$2^h46^m03\overset{s}{.}4$	$+34°56'10''$	$15\overset{m}{.}20$
$2^h45^m47\overset{s}{.}6$	$+34°55'02''$	$15\overset{m}{.}53$
$2^h45^m57\overset{s}{.}1$	$+34°52'44''$	$15\overset{m}{.}90$
$2^h46^m08\overset{s}{.}6$	$+34°58'03''$	$16\overset{m}{.}46$
$2^h46^m03\overset{s}{.}9$	$+34°57'10''$	$16\overset{m}{.}74$
$2^h46^m14\overset{s}{.}3$	$+34°53'42''$	$17\overset{m}{.}2$
$2^h46^m04\overset{s}{.}8$	$+34°55'26''$	$17\overset{m}{.}4$
$2^h46^m10\overset{s}{.}2$	$+34°52'44''$	$17\overset{m}{.}6$

Transformed to a standard system:	B_{pg}
Standard stars (field) used:	Calibrated using the blue magnitudes of neighboring stars from the GSC 2.2 catalogue.

Date(s) of the observation(s):
1963–1994

Availability of the data:
Upon request

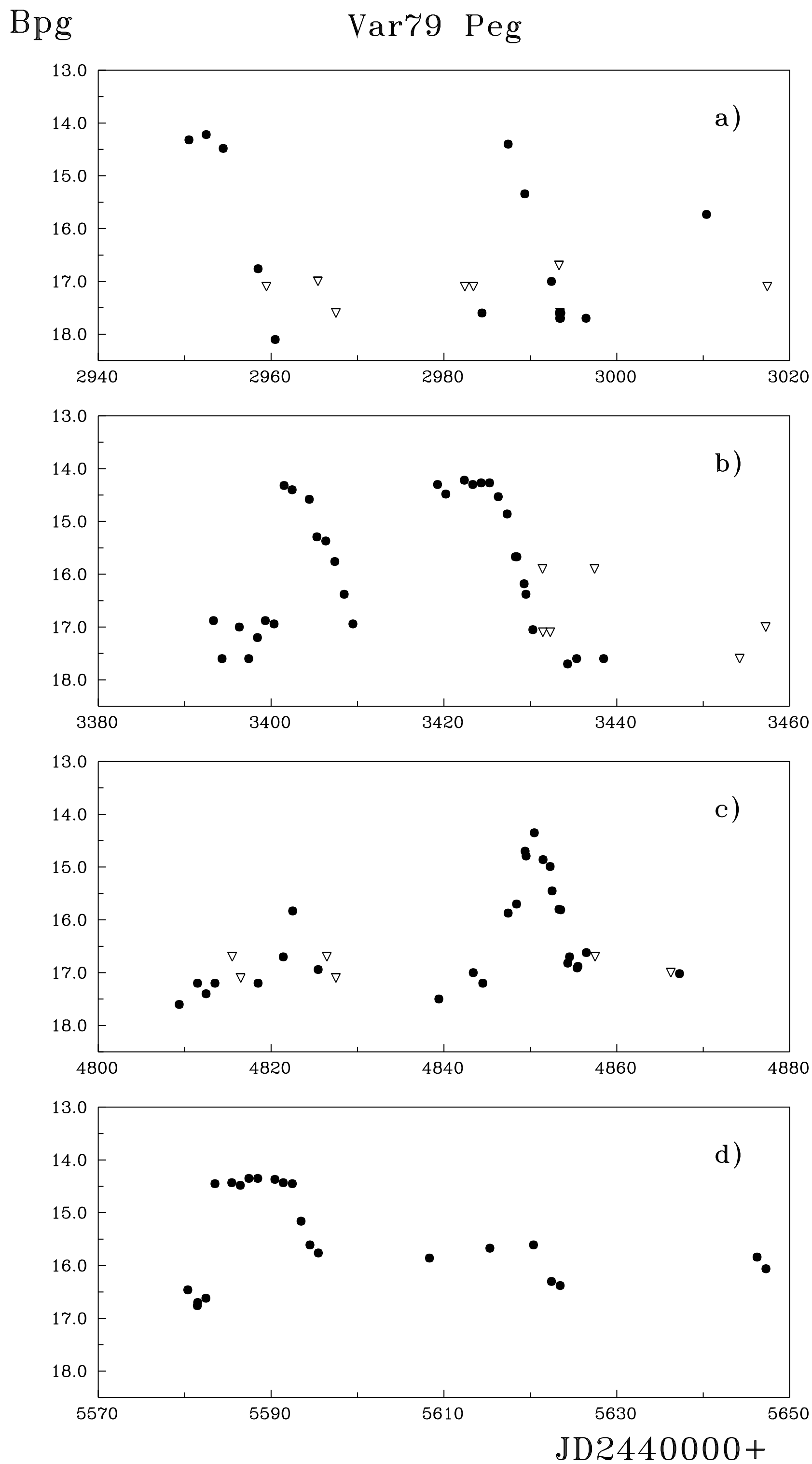

Figure 3. The sample light curves of Var 79 Peg. Open triangles: brighter limits.

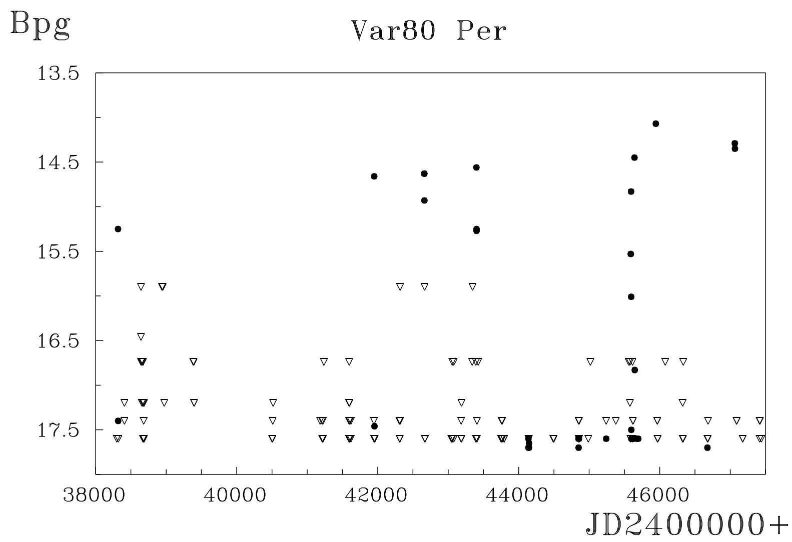

Figure 4. The photographic light curve of Var 80 Per. Open triangles: brighter limits.

Type of variability:	UG

Remarks:

The new variable star was estimated on 205 plates (JD 2438101–49634). Eight outbursts have been revealed. The range of variability on Moscow plates is $14^{\rm m}\!.1$–$<17^{\rm m}\!.6$. All observed outbursts are relatively short-lasting. The finding chart and the light curve are shown in Fig. 1 and Fig. 4 respectively. Outbursts (JD24...):

#1	38317.504	15.25	#4	43394.484	<17.6	#6	45642.438	14.45
	38319.426	17.40		43400.477	14.56		45645.374	16.83
	38322.332	<17.6		43401.544	15.25			
				43401.573	15.27	#7	45944.558	14.07
#2	41948.446	<17.6		43408.505	<17.6			
	41951.467	14.66				#8	47064.575	14.29
	41954.489	17.46	#5	45584.494	<17.6		47066.537	14.35
	41957.476	<17.6		45589.460	15.53			
				45593.547	14.83			
#3	42661.484	14.63		45595.550	16.01			
	42661.518	14.63		45597.546	17.60			
	42662.535	14.93		45597.578	17.50			
	42665.494	<15.9						
	42668.557	<17.6						

Acknowledgements:

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Voges, W., Aschenbach, B., Boller, Th., et al., 2000, *IAU Circ.*, No. 7432, ROSAT All-Sky Survey Faint Source Catalogue (RASS-FSC)

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DIFFERENTIAL PHOTOMETRY OF AW Vir IN APRIL 2004

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The solar analogy of activity has been widely studied on a variety of active late-type stars. Here we present the study of activity centers (spots) on W-type overcontact binary AW Vir.

AW Vir (GSC 00303-00887,F8, m_V=11.0) is an eclipsing binary on which the photographic variability was reported in 1935 (Hoffmeister 1935). Since then, few both photoelectric and CCD observations have been made to obtain the minima times (2002 data, e.g. Agerer & Hubscher 2003). Detailed light curve analysis was made by Niarchos et al. (1997), who derived the mass ratio q, the masses and radii of components and found one cool spot on the primary (more massive and cooler) component (February 1982 dataset). Qian (2003) paid attention to the period changes of the system ($\sim 10^{-8}$ d.y^{-1}) and introduced a quadratic term in the minima ephemeris. He still found the $O-C$ diagram considerably scattered. We obtained new observations in April 2004 to fill in the gap in the observations and to continue tracing the activity signatures (spots) on this system. Such studies are important as the tidal effects on spots should be present on systems similar to AW Vir and, in addition, magnetic-induced activity cycles (magnetic flux tubes evolution) are of interest as well. The star was monitored during the spring season 2004 using the 0.6m telescope at Stará Lesná Observatory equipped with a single channel photometer.

Table 1: The log of observations.

Date	Filter	Obs.	S−CH
14.4.2004	BV	SL	0.02
15.4.2004	BV	SL	0.03
21.4.2004	BV	SL	0.03
22.4.2004	BV	SL	0.05

The standard differential BV photometry with the sequence ... S – V – CH ... was made as well as standard reduction process including the corrections for differential extinction. The check star (CH) was SAO 119 944 and the standard star (S) was SAO 119 935. The following linear ephemeris has been used

$$\mathrm{MinI} = \mathrm{HJD}\ 2\ 445\ 022.6528 + 0\overset{\mathrm{d}}{.}35399712\ \times E \qquad (1)$$

being very close to previous determinations.

The complete dataset is presented in Table 1 (raw data are available only electronically via IBVS web-page as files 5574-t4 – t10.txt). The final analysis was made using the code of Djuraševič, see Djuraševič et al. (2004) for the details.

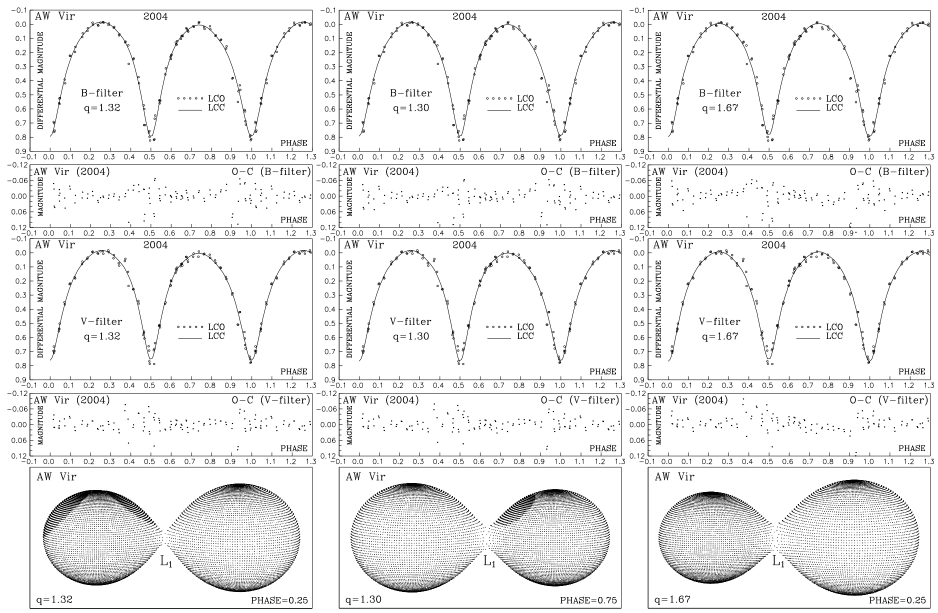

Figure 1. Observed (LCO) and final synthetic (LCC) light curves of AW Vir with final $O-C$ residuals obtained by analysing B and V observations **(left - two spots hypothesis ; middle - one spot hypothesis; right - without spots)** and the corresponding view of the system obtained with the resulting parameters.

Table 2: Times of minima.

Date	Filter	Min.	Min. type	$O-C$	$(O-C)$
14.4.2004	B	53110.4280	I	0.26	0.25
14.4.2004	V	53110.4278	I	0.25	0.25
15.4.2004	B	53111.4894	I	0.26	0.25
15.4.2004	V	53111.4897	I	0.26	0.25
21.4.2004	B	53117.3291	II	0.08	0.07
21.4.2004	V	53117.3308	II	0.08	0.07
22.4.2004	B	53118.3935	II	0.08	0.07
22.4.2004	V	53118.3961	II	0.09	0.08

Note: $(O-C)$ by Qian (2003).

The results are presented in Table 3. The shape of the light curve changed since the previous study (Niarchos et al. 1997) and we found the activity centers on the less-massive and hotter component. Though we could not decide between single and/or two-spot models, the spots cooler than the surrounding photosphere at intermediate latitudes confirm the tidal effect just with their locations. The system without spots gives the worst fit to the light curves. In addition, the mass ratio of the components had to be changed. The spots on the more-massive components are unrealistic as well, what is demonstrated with the convergence properties of the modelling. The times of minima do not fit well the quadratic ephemeris of Qian (2003) and at least suggest the importance of spots in the system. The overcontact factor for the binary is up to 10%. The times of minima derived by us are presented in Table 2.

Acknowledgements: The referee is cordially thanked for valuable comments.

Table 3: Results of the simultaneous analysis of the AW Vir B,V light curves obtained by solving the inverse problem for the Roche model with and without spots on the less-massive (hotter) component.

Quantity	Hip. I. – two spots	Hip. II. – one spot	Hip. III. – without spots
n	202	202	202
$\Sigma(\mathrm{O-C})^2$	0.1924	0.1954	0.2453
σ	0.0309	0.0312	0.0349
$f_{\mathrm{h,c}}$	1.0	1.0	1.0
$\mathrm{A_{h,c}}$	0.5	0.5	0.5
$\beta_{\mathrm{h,c}}$	0.08	0.08	0.08
$\mathrm{T_h}$	6200	6200	6200
$\mathrm{A_{s1} = T_{s1}/T_h}$	0.65 ± 0.08	0.66 ± 0.12	
θ_{s1}	33.8 ± 1.8	25.2 ± 1.8	
λ_{s1}	351.2 ± 2.2	344.1 ± 4.1	
φ_{s1}	45.2 ± 4.7	39.5 ± 5.5	
$\mathrm{A_{s2} = T_{s2}/T_h}$	0.93 ± 0.01		
θ_{s2}	40.4 ± 2.2		
λ_{s2}	183.4 ± 4.9		
φ_{s2}	40.9 ± 4.1		
$\mathrm{T_c}$	6078 ± 23	6189 ± 23	6100 ± 26
$\mathrm{F_h}$	1.006 ± 0.002	1.020 ± 0.002	1.029 ± 0.003
i [°]	82.1 ± 0.4	83.3 ± 0.4	83.8 ± 0.4
$q = m_{\mathrm{c}}/m_{\mathrm{h}}$	1.32 ± 0.04	1.30 ± 0.05	1.67 ± 0.06
$a_1^{\mathrm{h,c}}$[B]	+0.3369, +0.3645	+0.3369, +0.3395	+0.3369, +0.3594
$a_2^{\mathrm{h,c}}$[B]	+0.5521, +0.3976	+0.5521, +0.5378	+0.5521, +0.4262
$a_3^{\mathrm{h,c}}$[B]	+0.0590, +0.2836	+0.0590, +0.0798	+0.0590, +0.2419
$a_4^{\mathrm{h,c}}$[B]	−0.1039, −0.1940	−0.1039, −0.1123	−0.1039, −0.1773
$a_1^{\mathrm{h,c}}$[V]	+0.4165, +0.4408	+0.4165, +0.4187	+0.4165, +0.4363
$a_2^{\mathrm{h,c}}$[V]	+0.5507, +0.4218	+0.5507, +0.5387	+0.5507, +0.4457
$a_3^{\mathrm{h,c}}$[V]	−0.1962, +0.0071	−0.1962, −0.1774	−0.1962, −0.0306
$a_4^{\mathrm{h,c}}$[V]	−0.0039, −0.0937	−0.0039, −0.0122	−0.0039, −0.0771
$\Omega_{\mathrm{h,c}}$	4.2273	4.1612	4.6842
Ω_{in}	4.2471	4.2233	4.7788
Ω_{out}	3.6798	3.6571	4.1935
f_{over}[%]	3.48	10.98	16.16
$\mathrm{R_{h,c}[D=1]}$	0.336, 0.381	0.341, 0.385	0.323, 0.408
$\mathrm{L_h/(L_h+L_c)(B;V)}$	0.433; 0.432	0.433; 0.433	0.410; 0.409

Note: n - total number of the B and V observations, $\Sigma(\mathrm{O-C})^2$ - final sum of squares of residuals between observed (LCO) and synthetic (LCC) light curves, σ - standard deviation of the observations, $q = m_{\mathrm{c}}/m_{\mathrm{h}}$ - mass ratio of the components, $f_{\mathrm{h,c}}$, $\beta_{\mathrm{h,c}}$, $\mathrm{A_{h,c}}$ - nonsynchronous rotation coefficients, gravity-darkening exponents and albedo of the components, $T_{h,c}$ - temperature of the hotter primary and cooler secondary, $\mathrm{A_{S1,2}}$, $\theta_{\mathrm{S1,2}}$, $\lambda_{\mathrm{S1,2}}$ and $\varphi_{\mathrm{S1,2}}$ - spots temperature coefficients, angular dimensions, longitudes and latitudes (in arc degrees), $\mathrm{F_{h,c}}$ - filling factors for the critical Roche lobe of the hotter (less-massive) star, i [°] - orbit inclination (in arc degrees), $a_1^{\mathrm{h,c}}$, $a_2^{\mathrm{h,c}}$, $a_3^{\mathrm{h,c}}$, $a_4^{\mathrm{h,c}}$ - nonlinear B and V limb-darkening coefficients of the components (Claret's formula), $\Omega_{h,c}$, Ω_{in}, Ω_{out} - dimensionless surface potentials of the components and of the inner and outer contact surfaces respectively, f_{over}[%] - degree of overcontact, $R_{h,c}$ - polar radii of the components in units of the distance between the component centre and $\mathrm{L_h/(L_h+L_c)}$ - (B;V) luminosity of the hotter star (including spots).

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DETECTION OF THE ROTATIONAL PERIOD OF HD 179949?

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HD 179949 (HR 7291, HIP 94645, Spectral class F8-F9) was reported to be a 51 Peg-type star having a planetary companion with a minimum mass of 0.84 ± 0.05 $\mathrm{M_{Jupiter}}$ orbiting in a slightly eccentric orbit $e = 0.05$ with the period of 3.093 days (Tinney et al. 2001).

Recently, Shkolnik (2004) confirmed the planetary orbit. She detected sinusoidal radial-velocity variations of HD 179949 with the 3.093-d period and a full amplitude of about 250 $\mathrm{ms^{-1}}$. She also reported the modulation of the strength of the Ca II K emission of HD 179949 with the orbital period of the planetary companion and interpreted it as a convincing case of planet-induced activity. She pointed out the need for determination of the rotational period of HD 179949.

We attempted to detect the light variations of HD 179949. Our new photoelectric UBV observations were obtained with the modular photometer utilizing a Hamamatsu EA1516 photomultiplier attached to the 0.5-m telescope at the Sutherland site of the South African Astronomical Observatory (SAAO) during two weeks in April/May 2004. The photoelectric measurements were carried out by MW through the UBV filters of the Johnson's photometric system with 10-second integration time. All observations were carefully reduced to the Cousins E-region standard system (Menzies et al. 1989) and corrected for differential extinction using the reduction program HEC 22 rel. 14 (Harmanec & Horn 1998). The standard errors of these measurements were about $0\overset{\mathrm{m}}{.}009$, $0\overset{\mathrm{m}}{.}007$ and $0\overset{\mathrm{m}}{.}006$ in U, B and V filters, respectively. The nearby star 42 Sgr (also HR 7292, HIP 94643, Sp. K0), the constancy of which was verified from its Hipparcos H_p photometry (Perryman et al. 1997) served as the only comparison star. (Since the observations were carried out along with another observing program, we regrettably did not observe any check star.) Extinction and its mild time variability during each the night were taken into account, although the effect for differential photometry was small in this particular case. We derived the following very accurate mean all-sky values of UBV magnitudes and colour indices of the comparison 42 Sgr

$$V = 4\overset{\mathrm{m}}{.}860 \pm 0\overset{\mathrm{m}}{.}013,\ B-V = 0\overset{\mathrm{m}}{.}566,\ U-B = 0\overset{\mathrm{m}}{.}317$$

and of HD 179949:

$$V = 6\overset{\mathrm{m}}{.}237 \pm 0\overset{\mathrm{m}}{.}012,\ B-V = 0\overset{\mathrm{m}}{.}550,\ U-B = 0\overset{\mathrm{m}}{.}061\,.$$

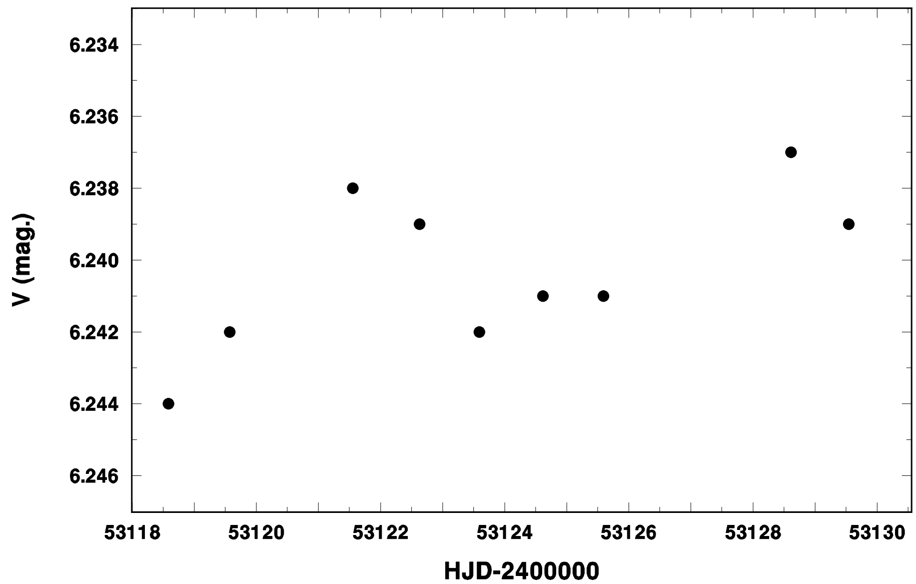

Figure 1. Normal points of SAAO V photometry of HD 179949.

The differential photometry of HD 179949 relative to 42 Sgr gives exactly the same values as the above quoted all-sky values, which indicates that the reduction to the standard system was reliable.

We also transformed the H_p Hipparcos photometry (Perryman et al. 1997) to Johnson V magnitudes using the colour indices derived by us and the transformation formula derived by Harmanec (1998) and obtained $V = 6\overset{\mathrm{m}}{.}243 \pm 0\overset{\mathrm{m}}{.}007$, in an excellent agreement with the SAAO result. Having such accurate determination, we used the Hipparcos parallax and the above V magnitude estimates, bolometric correction after Code et al. (1976) and Popper's (1980) $T_{\rm eff}$ scale to obtain the stellar radius:

$R = 1.25 \pm 0.03 R_\odot$ for F8 (SIMBAD database), or

$R = 1.30 \pm 0.03 R_\odot$ for F9 (Groot et al. 1996).

According to our experience, the V band photometry is the most accurate (lower extinction, small colour transformation terms, flat energy distribution) for detection of any brightness changes. The SAAO V photometry (normal points consisting of 3-5 individual observations for each night) is presented in Fig. 1. It seems to show smooth variation with a possible time scale of about 7 days. We also carried out a Stellingwerf (1978) period analysis of Hipparcos photometry from 20 days down to 0.5 days (with the standard (5,2) bin/cover structure) to find out independently a significant period of 7.07-day. Combining both data sets and allowing for the small zero point shift, we found finally a period of 7.06549 ± 0.00061 days from a sinusoidal fit to the combined data set. The phase plot in Fig. 2 is based on all SAAO and transformed Hipparcos *individual* V observations.

With the above derived radius and identifying the 7.065-day period with the stellar rotational period, one obtains the equatorial rotational velocity of HD 179949 of about 9.3 km/s. Groot et al. (1996) derived an accurate value of the projected rotational velocity of HD 179949: $v \sin i = 6.3$ km/s. This would imply an inclination of rotational axis of HD 179949 of about 45°. This is a very plausible value since such intermediate inclinations are usually most favourable to the detection of rotation-associated phenomena, both in the spectra and in photometry.

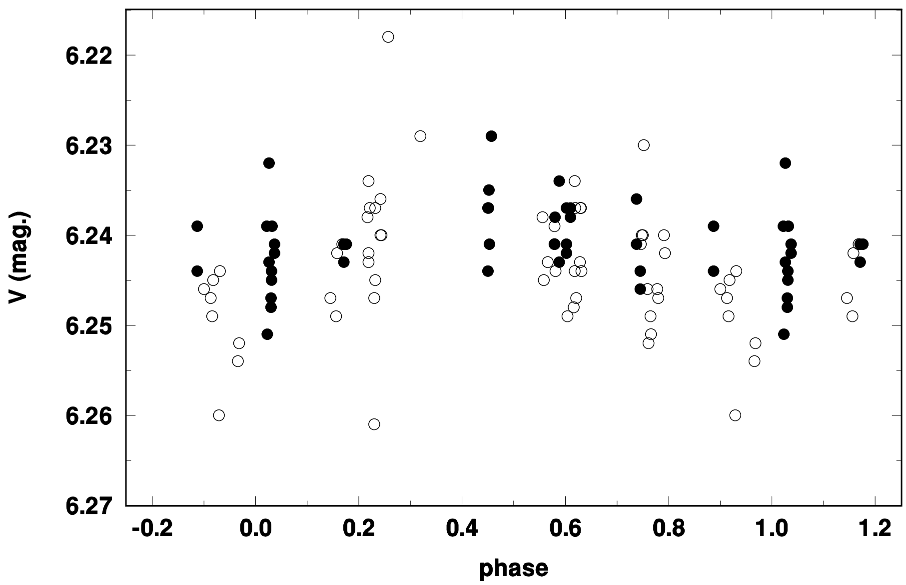

Figure 2. Individual SAAO (•) and Hipparcos V (○) observations of HD 179949 plotted vs. phase of the 7.06549-d period.

We therefore tentatively conclude that the 7.06549-d period is indeed the rotational period of the star. No doubt, however, that more photometric observations in excellent observing conditions are needed to verify our result. The same is actually true also for the Ca II flux observations of Shkolnik (2004) although the phase dependence on the planetary period seems quite impressive. She claims that the PDM Stellingwerf period search detected a period near 3 days as the best one in her Ca II K data but does not mention which bin/cover structure she used. We found that using different bin/cover structures like (5,2), (4,3) or (4,4) we detected different possible periods as the best ones, never a period near 3 days. A very good phase diagram was found, for instance, for a period of 1.42079 days but this can be a fortuitous coincidence only. Plotting the Ca II flux vs. phase of the 7.065-d period does not give a convincingly looking phase diagram.

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THE SHORT-TIME VARIABILITY OF GRB021004

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The gamma-ray burst (GRB) GRB021004 was detected by the FREGATE, WXM, and SXC instruments on board the *High Energy Transient Explorer II (HETE-II)* at 12:06:13.57 UT on 2002 October 4 (Shirasaki et al., 2002). At 48 seconds after the detection, the WXM localized coordinate was informed via the GRB Coordinates Network (GCN), and optical follow-up observations started immediately. The optical afterglow was identified as a object at R.A. $00^{\mathrm{h}}26^{\mathrm{m}}54\overset{\mathrm{s}}{.}674$ Dec. $+18^\circ55'41\overset{''}{.}59$ (J2000), determined by Henden & Levine (2002) with brightness of $\sim$15 mag at 9.45 minutes after the burst (Fox, 2002). The optical spectra of the afterglow showed two MgII absorption systems which revealed $z = 1.38$ and 1.60 (Fox et al., 2002; Eracleous et al., 2002; Anupama et al., 2002) and the multi-component Lymanα systems revealed $z \sim 2.3$ (Chornock & Filippenko, 2002; Sahu et al., 2002; Salamanca et al., 2002; Savaglio et al., 2002; Castro-Tirado et al., 2002). GRB021004 is the first case of the particularly observed the variability of magnitudes and colors from early time. In this paper we present the results of the $VRcIc$ time-resolved photometry from 0.078 to 0.336 days after the burst.

We started the observation of GRB021004 at 13:56:48 UT on 2002 October 4, using the Bisei Astronomical Observatory (BAO) 1.01-m telescope. At first an hour, we imaged the 12-field mosaic for covering the entire WXM error box in R_c band, and after identified the afterglow potion by Fox (2002), pointed the telescope to center of the afterglow and repeated Rc band exposures during 30 min. After that, for 4.5 hours until the sunrise, the VR_cI_c multicolor observation was continued. The electric cooled CCD camera CV-16IIE (assembled by MUTOH Industries Ltd. and Koheishya, Japan) was attached to the bend-cassegrain focus. The detector is a Kodak KAF-1602E with 1536×1024 pixels and a pixel size of 9 μm. The field of view is 7.8×5.2 arc minutes and the 3×3 pixels were read out as one pixel corresponded to a 0.9 arc seconds square. The instrumental gain is 4.43 e-/ADU and the noise included the read-out and dark is 37.1 e-. The exposure time for the object was set to 60 seconds. The object frames were dark-subtracted and flat-fielded. The several images were stacked for improving S/N. The photometric procedure was made with APPHOT in IRAF. The reference star for magnitude calibration was used R.A. $00^h26^m58^s.77$ Dec. $+18°56'56''.1$ (J2000), $V = 16^m.258 \pm 0^m.006$, $R_c = 15^m.538 \pm 0^m.016$, $I_c = 14^m.896 \pm 0^m.028$ (Henden, 2002).

The VR_cI_c light curves of the optical afterglow of GRB021004 obtained by our observation and the unfiltered data of Uemura (2003) are shown in Figure 1. These are obviously deviation from simple power-law decay, whose decay index seems to change steeper between 0.1 and 0.2 days. The colors ($V - R_c = 0^m.46 \pm 0f^m.12, R_c - I_c = 0^m.52 \pm 0^m.10$) did not change within photometric errors during our multicolor observation.

The R_c band magnitudes exhibited short-time variation. The first two points in R_c band at $t \sim 0.07 - 0.09$ days were kept with 16.4 mag. After that, it was temporary fading to 16.6 mag at $t \sim 0.1$ days and brightened up to 16.5 mag at $t \sim 0.11$ days. The time interval of this short-time variation was within ~30 min. This "dip" behavior could be found in the unfiltered data of Uemura (2003). Furthermore the brightness of the afterglow was constant $t \sim 0.25 - 0.29$ days (~1 hour) and fading again after $t \sim 0.3$ days. Similar bumps also appeared in later observations (e.g. Bersier et al., 2003).

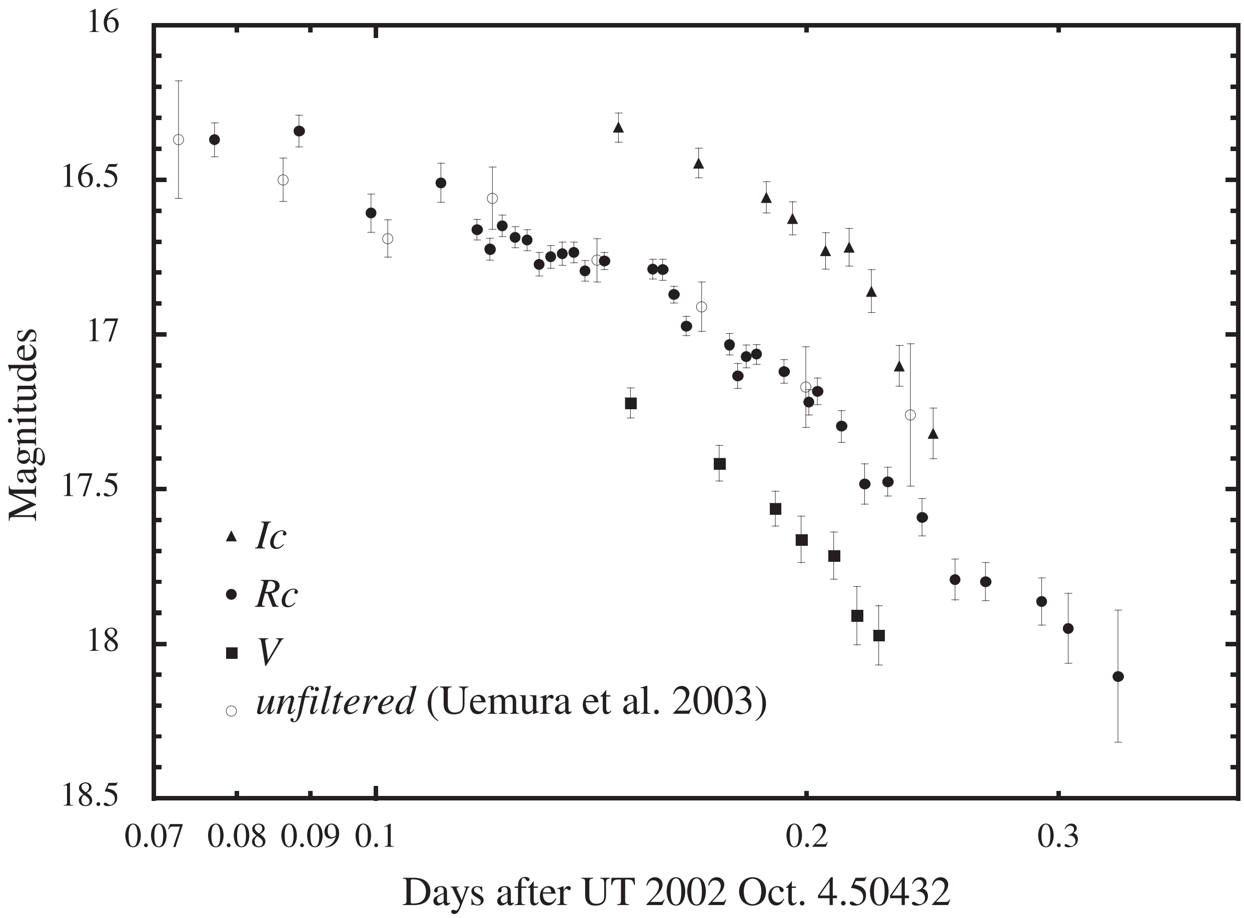

Figure 1. The VR_cI_c light curves of the optical afterglow of GRB021004

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ERRATUM FOR IBVS 5531

Figure captions in this issue are swapped, Fig. 1. shows the primary eclipse, while Fig. 2. is the secondary eclipse.

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NEW TIMES OF MINIMA OF SOME ECLIPSING VARIABLES

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Observatory and telescope:
URSA Observatory at the University of Arkansas (ursa.uark.edu); 10-inch Schmidt-Cassegrain reflector.

Detector:	1020×1530 pixels SBIG ST8EN CCD cooled to (typ.) -20 °C; 1.15 arcsec square pixels; $20'$(N-S)$\times30'$(E-W) field of view.

Method of data reduction:
Virtual measuring engine (Measure 1.98) written by C.H.S. Lacy (2004)

Method of minimum determination:
Kwee & van Woerden (1956)

Times of minima:

Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
AP And	53201.79472	0.00015	1	V	
	53205.76349	0.00019	2	V	
	53220.84197	0.00010	1	V	
	53302.5867	0.0004	2	V	
CO And	53230.7632	0.0003	2	V	
CG Aur	52990.8095	0.0003	1	V	
	53076.5867	0.0011	2	V	
	53085.6104	0.0010	2	V	
HP Aur	52985.7101	0.0010	2	V	
	53074.63505	0.00011	1	V	
	53079.61465	0.00016	2	V	
TX Boo	53104.7691	0.0009	1	V	
V381 Cas	52990.55032	0.00013	2	V	
	53003.61975	0.00025	1	V	
V389 Cas	53190.8378	0.0006	1	V	
V459 Cas	52988.58525	0.00014	1	V	
	52992.74846	0.00019	2	V	
	53026.58164	0.00014	2	V	
V651 Cas	53281.88754	0.00019	2	V	
IO Cep	52985.5526	0.0007	2	V	
	53128.9016	0.0008	2	V	
	53190.7000	0.0005	2	V	
	53198.7274	0.0003	1	V	
	53219.73559	0.00017	1	V	
	53229.62236	0.00021	1	V	

Times of minima:					
Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
V456 Cyg	53109.9156	0.0003	2	V	
	53130.85712	0.00010	1	V	
	53197.69705	0.00011	1	V	
	53229.78003	0.00006	1	V	
V974 Cyg	53146.7796	0.0007	1	V	
	53157.9032	0.0004	2	V	
	53231.6053	0.0007	2	V	
V1061 Cyg	53145.8083	0.0006	2	V	
	53293.6434	0.0003	2	V	
LV Her	53209.7288	0.0004	1	V	
RW Lac	52984.62075	0.00020	2	V	
	53295.69757	0.00016	2	V	
UX Leo	53003.9218	0.0005	2	V	
	53053.77763	0.00019	1	V	
	53056.79837	0.00012	1	V	
	53062.84173	0.00015	1	V	
	53063.84872	0.00012	1	V	
	53112.6948	0.0013	2	V	
SX Oph	53095.845	0.003	1	V	
	53097.9143	0.0007	1	V	
V506 Oph	53123.78251	0.00013	1	V	
	53132.79620	0.00014	2	V	
	53168.8507	0.0003	2	V	
FO Ori	53027.63660	0.00015	1	V	
V530 Ori	53004.7802	0.0009	2	V	
V648 Ori	53014.62683	0.00022	1	V	
IM Per	53033.6699	0.0003	1	V	
V482 Per	53032.6433	0.0003	1	V	
AQ Ser	53076.8397	0.0005	2	V	
	53109.7432	0.0005	1	V	
	53131.68080	0.00024	1	V	
	53169.6480	0.0007	2	V	
BI Ser	53032.9643	0.0008	2	V	
	53035.9751	0.0005	1	V	
	53111.8825	0.0004	1	V	
BP Vul	53169.8789	0.0006	2	V	

Remarks:
A sample of the observations has been published by Lacy, Hood & Straughn (2001).

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VRI PHOTOMETRIC OBSERVATIONS OF V1647 Ori (IRAS 05436-0007)

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Recently McNeil (2004) discovered a new reflection nebula located in the Orion L1630 molecular cloud and associated with the IRAS point source (05436-0007). The nebula is not seen on the POSS plates and an eruptive object like FUor or EXor (Reipurth and Aspin 2004) illuminates it. According to Samus (2004) the designation V1647 Ori has been given to the variable star associated with IRAS 05436-0007. Briceño et al. (2004) suggest that the outburst begun at some time between 2003 October 28 and November 15 and the point-like object illuminating the nebula rose by 5 mag in about 4 months. They found the spectrum of V1647 Ori similar to the early outburst spectrum of FUor star V1057 Cyg. Based on near-infrared spectroscopy Vacca et al. (2004) state that V1647 Ori is a low-mass late-stage Class I protostar surrounded by a circumstellar disk. Walter et al. (2004) report a general decline of brightness of V1647 Ori by $0\overset{m}{.}4$ (I) in the period February 10 - May 7. The bolometric luminosity of V1647 Ori estimated by Andrews al. (2004) is 3.4 $L\odot$. Ábrahám et al. (2004) state that the IR SED of V1647 Ori resembles the SEDs of FUor objects.

In this paper we present data from VRI photometric observations of V1647 Ori in the period August 18 - October 3 immediately after the beginning of morning visibility. Our observations were made with the 1.3-m RC telescope of the Skinakas Observatory[1] of the Institute of Astronomy, University of Crete (Greece). The Photometrics CCD camera 1024×1024 pixels was used. The size of the pixel is 24 μm and the scale is $0\farcs5$/pixel. All frames were taken through a standard Johnson-Cousins set of filters. The typical FWHM during our observations with the 1.3-m telescope is $1\farcs5$. Aperture photometry was performed using DAOPHOT routines. In order to minimize the light from the surrounding nebula we used a $2\farcs5$ (5 pixel) radius aperture. The background is taken between radii 20 and 25 pixels. In the case of a $2\farcs0$ (4 pixel) radius aperture the estimated star brightness decrease by 0.04-0.05 mag.

In order to facilitate transformation from instrumental measurement to the standard system we tried to calibrate in VRI bands all bright stars in the field of view of the 1.3-m telescope ($8\farcm5 \times 8\farcm5$). Calibration was made during two clear nights August 20/21 and October 1/2. Standard stars from Landolt (1992) were used as reference. The finding chart of the comparison sequence is present in Fig. 1. Table 1 contains the photometric data for the VRI comparison sequence. The corresponding mean errors of the mean are

[1]Skinakas Observatory is a collaborative project of the University of Crete, the Foundation for Research and Technology - Hellas, and the Max-Planck-Institut für Extraterrestrische Physik.

listed too. We confirm that the two brightest stars in the field LkHα 301 and the star V of Briceño et al. (2004) are variable. From our photometric data LkHα 301 varies with amplitudes $0\overset{m}{.}55(I)$ and $0\overset{m}{.}77(V)$ and the star V varies with amplitudes $0\overset{m}{.}78(I)$ and $1\overset{m}{.}29(V)$. We suspect that the stars A and F from our list are possible variables with small amplitudes and we advise the observers to use them with discretion.

The results from our CCD photometric observations are given in Table 2. The table contains Date, the Julian Date, the V, Rc and Ic magnitudes. Fig. 2 shows the V, Rc and Ic light curves of V1647 Ori for the period of our photometric observations. It is seen from the figure that V1647 Ori varies with amplitude of $0\overset{m}{.}5$ and a very slight decrease of brightness can be observed.

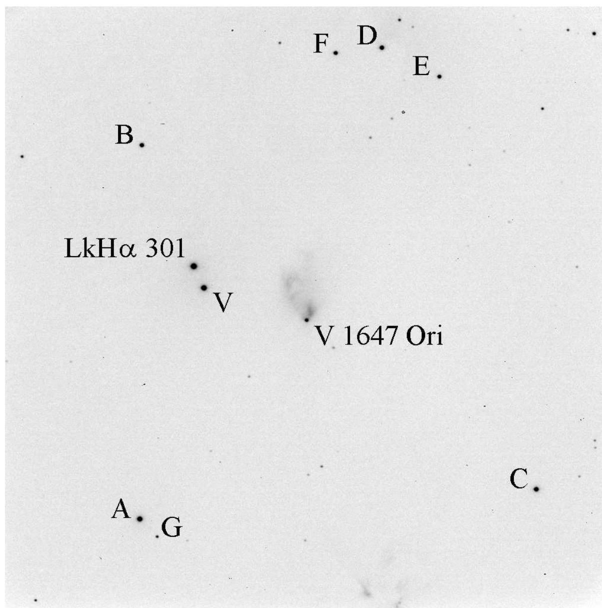

Figure 1. A finding chart of the comparison sequence in the field of V1647 Ori. The field is $8\overset{'}{.}5 \times 8\overset{'}{.}5$, centered on V1647 Ori. North is at the top and east to the left. The chart is a reproduction from an I CCD frame obtained with the 1.3-m RC telescope on Oct. 3, 2004. The stars are labeled from A to G in order of their V-band magnitude.

Table 1. Photometric data for VRI comparison sequence.

Star	V	σ_V	Rc	σ_R	Ic	σ_I
A	15.19	.03	14.15	.04	13.05	.05
B	15.66	.02	14.89	.03	14.23	.05
C	16.88	.03	15.45	.02	13.58	.06
D	17.85	.04	16.09	.06	14.00	.08
E	17.95	.03	16.38	.03	14.66	.02
F	18.60	.05	16.80	.03	14.64	.05
G	18.79	.04	17.90	.03	16.20	.05

There is only two papers (Briceño et al. 2004, Walter et al. 2004) containing optical photometric observations of V1647 Ori in the period of outburst. The authors use different

Table 2. Photometric observations of V1647 Ori in the period August - October 2004

Date	J.D.(245...)	*Ic*	*Rc*	*V*
2004 Aug 18	3235.603	14.79	16.97	18.56
2004 Aug 21	3238.601	14.70	16.83	18.33
2004 Sep 09	3257.585	14.65	16.78	–
2004 Sep 18	3266.614	14.49	16.67	18.11
2004 Sep 19	3267.616	14.47	16.71	18.10
2004 Sep 20	3268.606	14.46	16.65	18.03
2004 Sep 21	3269.556	14.61	16.81	18.28
2004 Sep 23	3271.599	14.71	16.92	18.41
2004 Sep 29	3277.508	14.81	17.02	–
2004 Sep 30	3278.502	14.77	16.96	–
2004 Oct 01	3279.510	14.75	16.87	18.42
2004 Oct 02	3280.618	14.84	16.97	18.50
2004 Oct 03	3281.611	14.90	17.06	18.58

apertures to estimate the brightness of the star, $4''\!.1$ in Briceño et al. (2004) and $1''\!.85$ in Walter et al. (2004). In the case of a larger aperture the measurements include much light from the nebulous background around the object. The comparison of our data with the data published by Walter et al. (2004) shows a general decline in brightness of about $0^{\mathrm{m}}\!.9$ (I) in the period February - October 2004. We find this decline real, because the expected errors from the different aperture used are of the order of 0.05 mag. The nebula surrounding V1647 Ori is variable also (Briceño et al. 2004) and its variability affects the estimated magnitudes. Therefore, the observed outburst of V1647 Ori was continued during the whole year.

The comparison of all available photometric data suggests that the light curve of V1647 Ori in the period of outburst resemble the well-studied FUor objects. The FUor or EXor outbursts are very rare phenomena but with a great importance for the pre-main sequence evolution. We know only a few objects from both classes and every new possible FUor or EXor attracts a great interest. Both FUors and EXors are characterized by large amplitudes of outburst (4-6 mag). While the EXors spend only a few weeks or months in the maximum brightness, the outbursts of FUors extend some decades. In the present the exact classification of V1647 Ori is not possible. The evidences for a previous outburst on 1966 (Mallas and Kreimer 1978) can be explained as a recurrent EXor event. The emission line spectrum and the low luminosity of V1647 Ori also support this statement. On the other hand the long time outburst, the light curve of the object and the observed SED (Ábrahám et al. 2004) are evidences for a new FUor event.

The author thanks the Director of Skinakas Observatory Prof. I. Papamastorakis and Prof. I. Papadakis for the telescope time.

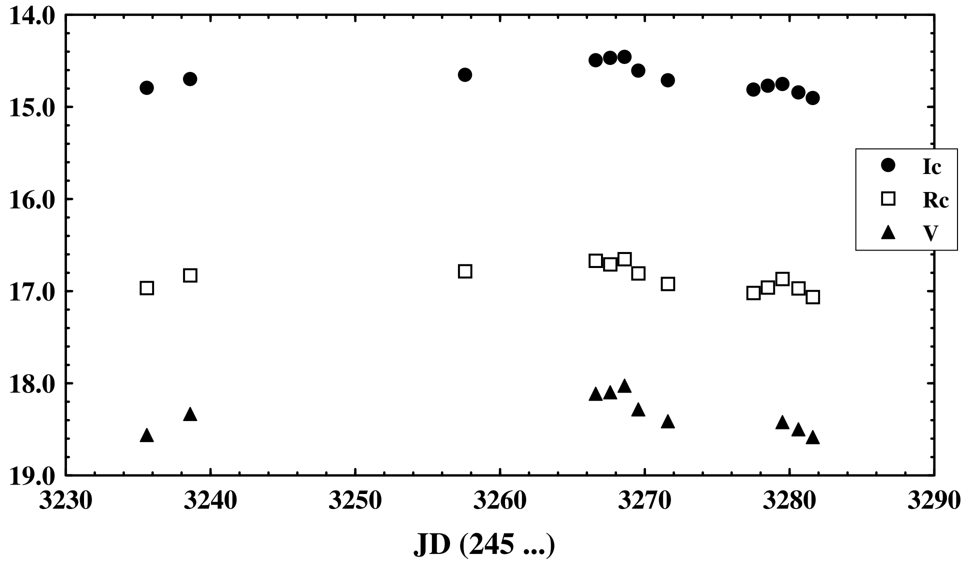

Figure 2. V, Rc and Ic light curves of V1647 Ori

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NEW TIMES OF MINIMA OF ECLIPSING BINARY SYSTEMS

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[4] Guest observer at Piszkéstető Observatory of Konkoly Observatory

[5] Guest observer at Baja Astronomical Observatory

Observatory and telescope:
50-cm $f/8.4$ Ritchey–Chrétien telescope (Ba50), and 20-cm $f/17.5$ Cassegrain telescope (Ba20) of the Baja Astronomical Observatory (Hungary) 50-cm $f/15$ Cassegrain telescope (Pi50), and 1m $f/13.3$ RCC telescope (Pi100) of the Konkoly Observatory at Piszkéstető Mountain Station (Hungary)

Detector:	512×512 Apogee AP-7 CCD camera (Ba50) $752 \times 488+$ SBIG ST7-E CCD camera (Ba20) cooled UBVRI Photometer (Pi50c) uncooled UBV Photometer (Pi50u) 1340×1300 Princeton Instr. CCD camera (Pi100)

Method of data reduction:
Reduction of the CCD frames was made with a customly developed IRAF[1] package.

Method of minimum determination:
The minima times were computed with parabolic fitting, and in some cases with linearized Pogson-method or Kwee-van Woerden method (Kwee & van Woerden, 1956).

[1]IRAF is distributed by the National Optical Astronomical Observatories, operated by the Association of the Universities for Research in Astronomy, inc., under cooperative agreement with the National Science Foundation

Times of minima:					
Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
RT And	52860.412	1	II	V	Kla/Ba20
AB And	52821.4956	1	II	R	Bor/Ba50
	53284.31894	5	I	V	Bor/Ba50
GZ And	53248.47974	3	II	V	Csiz/Pi100
HP Aur	52695.459	1	II	V	Bír/Ba50
IM Aur	52938.5294	1	I	V	Bír/Ba50
	52940.409	:	II	V	Bor/Ba50
IU Aur	52926.6129:	4:	II	V, R	Bor+Kós/Pi100
	52947.4423	4	I	V	Bor/Ba50
	52948.351	:	II	V	Bor/Ba50
	52975.5235	15	II	R, V, B	Bor/Ba50
	52976.4277	13	I	R, V, B	Bor/Ba50
	52994.5487	2	I	R	Bor/Ba50
	53034.4005	6	I	B	Bor/Ba50
	53034.4025	10	I	R, V	Bor/Ba50
SV Cam	46041.5485	11	I	V, B, U	Pat/Pi50u
	46292.4191	9	I	V, B, U	Pat/Pi50u
	48876.4387	6	I	V, B, U	Pat/Pi50u
	49555.5067	4	I	V, B, U	Pat/Pi50u
	50013.3582	9	I	V, B, U	Pat/Pi50u
VW Cep	52807.4268	3	II	R	Bor/Ba50
	53250.4972	7	II	R, V, B	Bor/Pi50c
	53255.3679	6	I	R, V, B	Pál/Pi50c
	53255.5064	3	II	R, V, B	Pál/Pi50c
AQ Com	52731.3728	2	II	–	Bír/Ba50
	52731.5132	4	I	–	Bír/Ba50
DK Cyg	53137.52685	9	I	V	Csiz/Pi100
MR Cyg	52795.492	2	II	R, V, B	Bír/Ba50
LS Del	52808.513	1	I	R	Heg/Ba50
AK Her	52794.4941	7	I	R, V, B	Bír/Ba50
	52801.4504	4	II	R, V, B	Bír/Ba50
	53129.3950	1	II	V	Bor/Ba50
	53136.3487	2	I	I	Csiz/Pi100
V994 Her	52836.4002	2	II	R	Heg/Ba50
SW Lac	52919.3187	1	I	V	Bor/Ba50
	52919.4798	1	II	V	Bor/Ba50
U Peg	52546.4145	14	II	R, V, B	Bír/Ba50
AU Ser	53196.41991	5	I	V	Csiz/Pi100
EQ Tau	52922.5529	5	II	R, V, B	Bor+Kós+Pál/Pi100
DW UMa	52055.41168	6	I	V	Bír/Ba50
	52345.3660:	3	II:	V	Bír/Ba50
	52345.4272	3	I	V	Bír/Ba50
	52345.56380	5	I	–	Bír/Ba50
LP UMa	52345.4232	8	II	V	Bír/Ba50
	52345.5815	4	I	–	Bír/Ba50
	53095.375	1	II	R	Bor/Ba50

Acknowledgements:

This work was partly supported by National Grant OTKA T034551.

Reference:

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THREE RR LYRAE STARS WITH VARIABLE PERIODS IN OPHIUCHUS

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These stars were reported to be variable by Hughes-Boyce and Huruhata (1942) and Hoffmeister (1931, 1968). No ephemerides were published for V824 Oph and V2030 Oph until today whereas the elements for V530 Oph listed in the GCVS are erroneous. Photographic plates of a field centered around 67 Oph, taken with the Sonneberg Observatory 40cm Astrograph during three intervals spread over the years from 1938 to 1994, were used to check the behaviour of these objects (see Table 1). The elements listed below were obtained by means of least-squares solutions.

Photographic amplitudes were derived with respect to magnitudes of the comparison stars given in Table 2. Individual data are available upon request.

Remarks:

V530 Oph

The elements for V530 Oph published by Hoffmeister (1943) were based on an alias period ($0^{d}.3995$). Times of maxima published in his paper were included in our period analysis and therefore also listed in Table 4. Maxima from 2429785-2429845 were reinvestigated from the plate series.
Elements valid for J.D. 2425500-2431700 and J.D. 2438200-2449500 resp.

V824 Oph

Elements valid for J.D. 2429100-2438500 and J.D. 2438500-2449500 resp.
The brightness of the star is just above the plate limit, so the true minimum magnitude might be somewhat below of the value given in the summary (see light curve). Five times of maxima observed around J. D. 2438500 were also used to derive a meaningful period value for the first set of elements. Despite this is quite arbitrary, it has turned out to be the only method to include the early observations in a good composite light curve as shown in Fig. 4. For this reason, ephemeris [1] should be used as preliminary because the true period change might be stronger than derived in this paper.

V2030 Oph

Elements valid for J.D. 2429100-2441200 and J.D. 2443300-2449500 resp.

This research made use of the SIMBAD data base, operated by the CDS at Strasbourg, France.

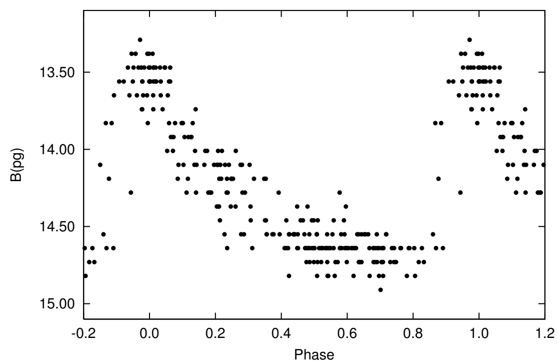

Figure 1. Composite light curve of V530 Oph

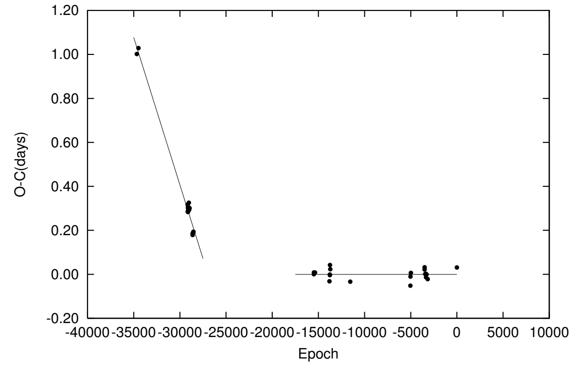

Figure 2. (O−C[2]) diagram for V530 Oph

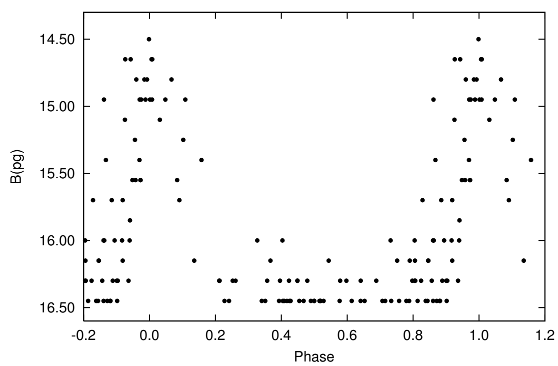

Figure 3. Composite light curve of V824 Oph

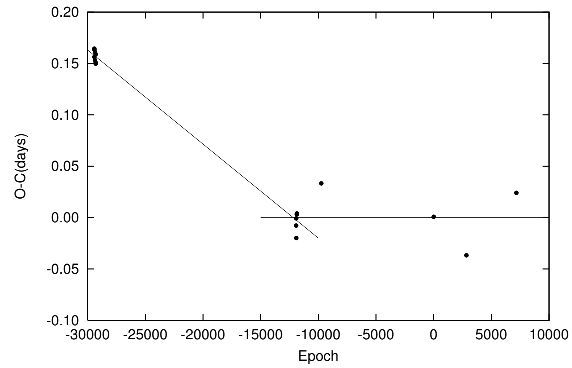

Figure 4. (O−C[2]) diagram for V824 Oph

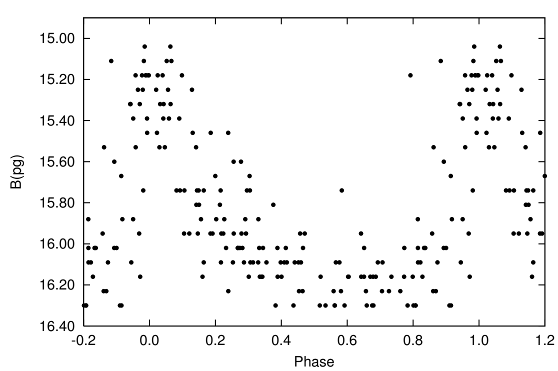

Figure 5. Composite light curve of V2030 Oph

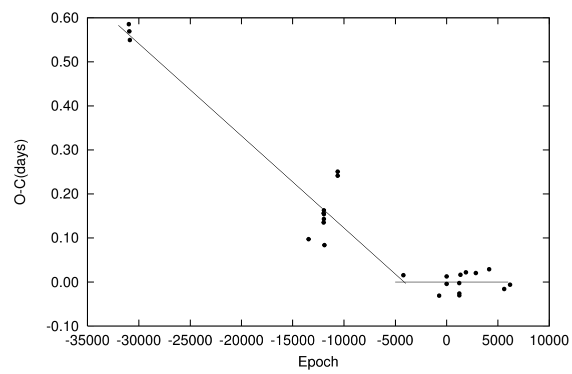

Figure 6. (O−C[2]) diagram for V2030 Oph

Table 1. Summary of this paper

Star	Type	Epoch 2400000+	Period (day)	Max.	Min.	M−m	No. of Plates
V530 Oph [1]	RRab	29843.409 ±8	0.6655105 ±36	$13^{m}_{.}5$	$14^{m}_{.}6$	$0^{p}_{.}20$	43
V530 Oph [2]		48839.361 ±10	0.6656445 ±10				219
V824 Oph [1]	RRab	29785.544 ±3	0.4995136 ±2	$14^{m}_{.}6$	$16^{m}_{.}4$	$0^{p}_{.}15$	42
V824 Oph [2]		44484.347 ±10	0.4995229 ±10				70
V2030 Oph [1]	RRab	29816.437 ±11	0.5197214 ±6	$15^{m}_{.}2$	$16^{m}_{.}2$	$0^{p}_{.}20$	98
V2030 Oph [2]		45912.433 ±7	0.5204025 ±23				74

Table 2. Comparison stars and cross references

	V530 Oph 227.1931 USNO 0900-10758622		V824 Oph HV 11045 USNO 0975-09721168	
Comp. No.	USNO	m*	USNO	m*
1	0900-10744874	$13^{m}_{.}2$	0975-09723366	$14^{m}_{.}0$
2	0900-10764580	$13^{m}_{.}8$	0975-09724472	$15^{m}_{.}5$
3	0900-10764415	$14^{m}_{.}9$	0975-09726442	$16^{m}_{.}8$

	V2030 Oph S 10353 USNO 0900-10900103	
Comp. No.	USNO	m*
1	0900-10891796	$14^{m}_{.}9$
2	0900-10897885	$15^{m}_{.}2$
3	0900-10888277	$15^{m}_{.}6$
4	0900-10895520	$16^{m}_{.}1$

* Magnitudes refer to the B values of the USNO−A2.0 catalogue

Table 3. Heliocentric times of maxima and $O-C$ values according to the elements derived in this paper; the more recent second set of elements was used in the cases with two given sets.

Star	JD (max.)	Epoch	$O-C$	Star	JD (max.)	Epoch	$O-C$
V530 Oph (1)	25762.468†	−6132	−0.031	V824 Oph (1)	29812.514	54	−0.004
	25882.311†	−5952	0.020		29816.518	62	0.004
	29429.485†	−622	0.023		29843.490	116	0.002
	29431.450†	−619	−0.008		29844.480	118	−0.007
	29449.420†	−592	−0.007		29845.480	120	−0.006
	29453.415†	−586	−0.005	V824 Oph (2)	38528.528	−11923	−0.008
	29455.430†	−583	0.014		38530.533	−11919	−0.001
	29459.430†	−577	0.020		38533.511	−11913	−0.020
	29469.403†	−562	0.011		38553.515	−11873	0.003
	29515.361†	−493	0.049		38557.512	−11865	0.004
	29541.289†	−454	0.022		39618.528	−9741	0.033
	29569.254†	−412	0.035		44484.348	0	0.001
	29785.466	−87	−0.044		45902.456	2839	−0.037
	29787.470	−84	−0.036		48067.449	7173	0.024
	29813.433	−45	−0.028	V2030 Oph (1)	29790.429	−50	−0.022
	29843.390	0	−0.019		29816.433	0	−0.004
	29845.389	3	−0.017		29843.474	52	0.012
V530 Oph (2)	38528.528	−15490	0.000		38910.515	17498	−0.006
	38530.533	−15487	0.008		39672.443	18964	0.011
	38614.404	−15361	0.008		39673.463	18966	−0.009
	39651.438	−13803	−0.032		39684.419	18987	0.033
	39681.420	−13758	−0.004		39685.440	18989	0.014
	39683.420	−13755	−0.001		39686.492	18991	0.027
	39685.460	−13752	0.042		39711.401	19039	−0.011
	39711.401	−13713	0.023		40384.439	20334	−0.012
	41150.468	−11551	−0.034		40385.489	20336	−0.001
	45486.458	−5037	−0.052	V2030 Oph (2)	43717.391	−4218	0.015
	45492.490	−5028	−0.011		45530.427	−734	−0.031
	45522.461	−4983	0.006		45912.446	0	0.013
	46507.630	−3503	0.021		45913.470	2	−0.004
	46509.637	−3500	0.031		46552.526	1230	−0.002
	46553.539	−3434	0.001		46553.539	1232	−0.030
	46609.454	−3350	0.002		46554.584	1234	−0.026
	46613.432	−3344	−0.014		46613.432	1347	0.016
	46649.390	−3290	−0.001		46885.608	1870	0.022
	46731.243	−3167	−0.022		47389.356	2838	0.020
	48839.392	0	0.031		48067.449	4141	0.029
V824 Oph (1)	29785.550	0	0.006		48832.396	5611	−0.016
	29786.550	2	0.007		49127.474	6178	−0.006
	29788.540	6	−0.001				

† Times published by Hoffmeister (1943)

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SPECTROSCOPIC CONFIRMATION OF THREE SUSPECTED BY Dra VARIABLES

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The BY Dra variables are late-type (G – M) over-active stars, showing photometric variability on time scales on the order of a few days. The variations are caused by stellar activity and surface nonuniformities probably in the form of large spots being rotated across the stellar disk. In the 77th namelist of variable stars (Kazarovets et al. 2003) there are three stars suspected of BY Dra type variability:

V573 Pup (SAO 154153, M0, V=8.$^{\rm m}$98) was discovered to be variable by Lebzelter & Posch (2001) with a period around 25 d. The authors were reluctant to classify it as a BY Dra type because of its unusually high $V-I$ amplitude compared to V amplitude.

HL Cnc (HD 77191, G0, $V=8.^{\rm m}86$) was presented as a solar twin by Lebzelter (2000), except for the photometric variation with a 10 d period, which were proposed to be due to stellar surface spots.

GQ Leo (GSC 00870-00798, K4, $V=10.^{\rm m}7$) is a known as an X-ray and EUV source (e.g. Mason et al. 1995), and was found by Robb et al. (2001) to show photometric variability with a period of 4.45 d. From the known X-ray and UV flux and the period, they argue that the star could be a BY Dra type variable.

We have obtained high-resolution (R $\sim$ 48 000) spectra of the three stars using FEROS at the ESO/MPI-2.20m telescope at La Silla Observatory, Chile. Standard data reduction was performed with MIDAS including bias and flatfield correction, order extraction and wavelength calibration. Flux calibration was performed using only one standard star observation. The spectra have a FWHM resolution of 0.15Å and cover the range 3800–9000Å.

In Figs. 1 and 2 we show the spectra of V573 Pup and HL Cnc around the Ca II H+K lines. The spectrum of GQ Leo shows very strong emission in H+K and Hα as shown in Fig. 3. As we show in Fig. 4, also the rest of the Balmer lines are in emission, and the Ca II triplet at $\lambda\lambda$ 8498, 8542, 8662 have strong emission cores, revealing an extremely active system, usually indicative of youth (e.g. Montes et al. 2001).

Over-active stars are often young and rapidly rotating. A commonly used indicator of youth is the lithium doublet at 6707.8 Å, which, as shown in Fig. 5, we find to be clearly present in GQ Leo and HL Cnc , while the red spectrum of V573 Pup is dominated by strong molecular absorption, typical for M-dwarfs.

At this resolution the Li lines are blended with a Fe I line at 6707.41 Å, and we measure the combined width to 95 mÅ for GQ Leo and 83 mÅ for HL Cnc using the *splot* tool of IRAF.

For HL Cnc we could measure nine of the line ratios established by Kovtyukh et al. (2003) to determine the effective temperature, and we find $T_{\rm eff} = 5765\,{\rm K} \pm 92\,{\rm K}$.

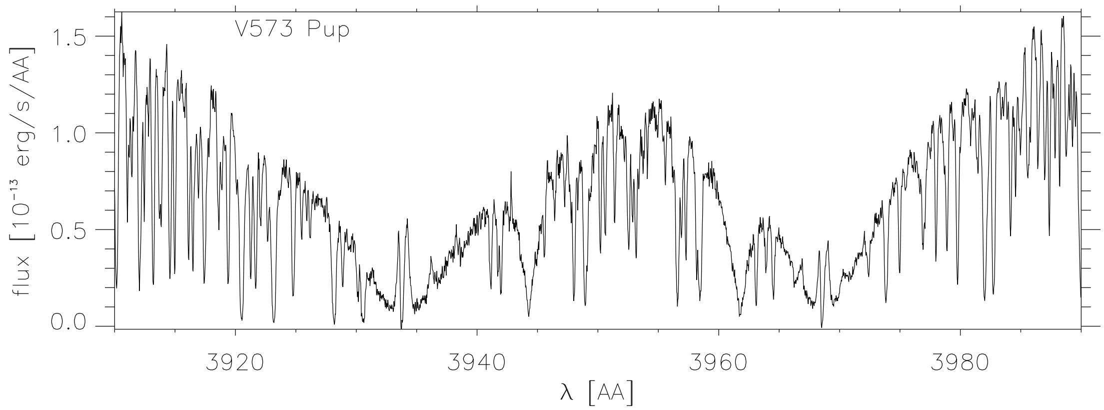

Figure 1. The Ca II H+K lines of V573 Pup. Note the very strong self-absorption.

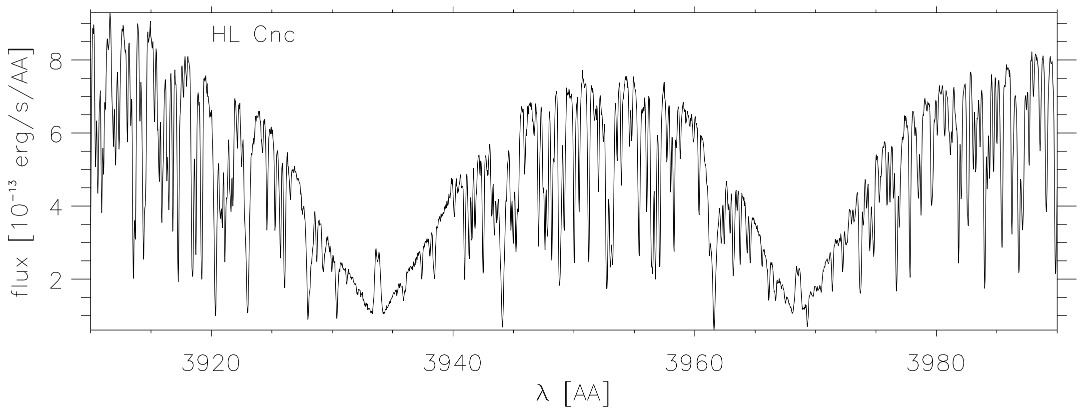

Figure 2. The Ca II H+K lines of HL Cnc. This is clearly an overactive star.

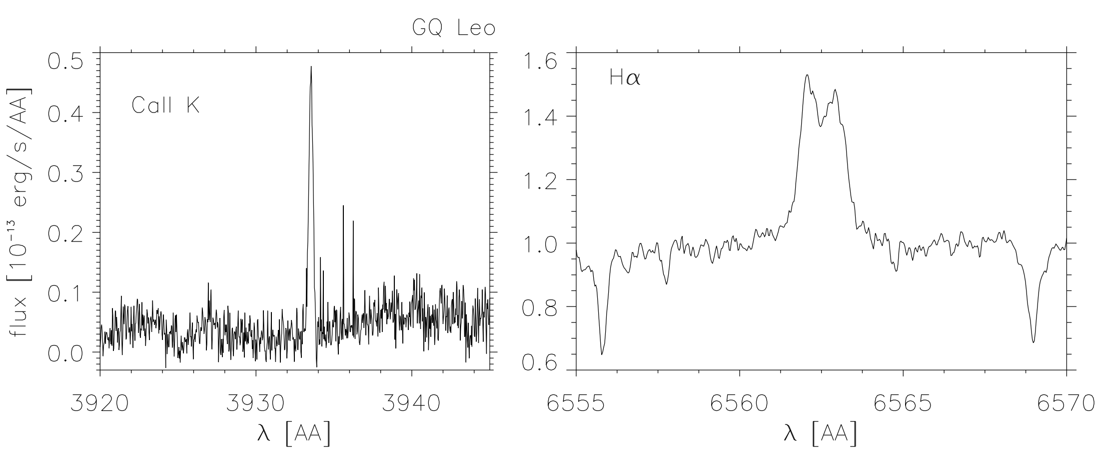

Figure 3. Ca II and Hα K of GQ Leo. This is obviously an extremely active object.

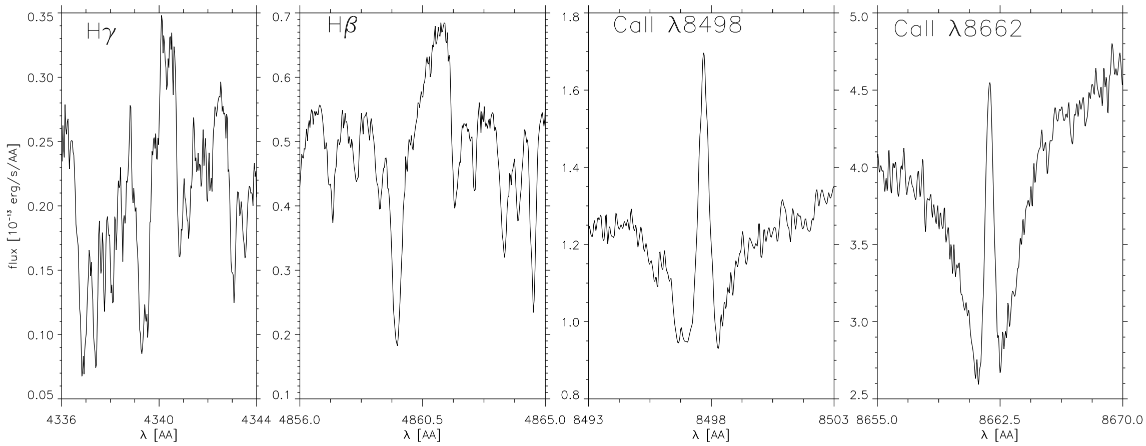

Figure 4. The Balmer lines of GQ Leo have clear emission or emission fill-in, while the Ca II infrared triplet have strong emission cores (λ8542 falls partly in an inter-order gap and is not shown).

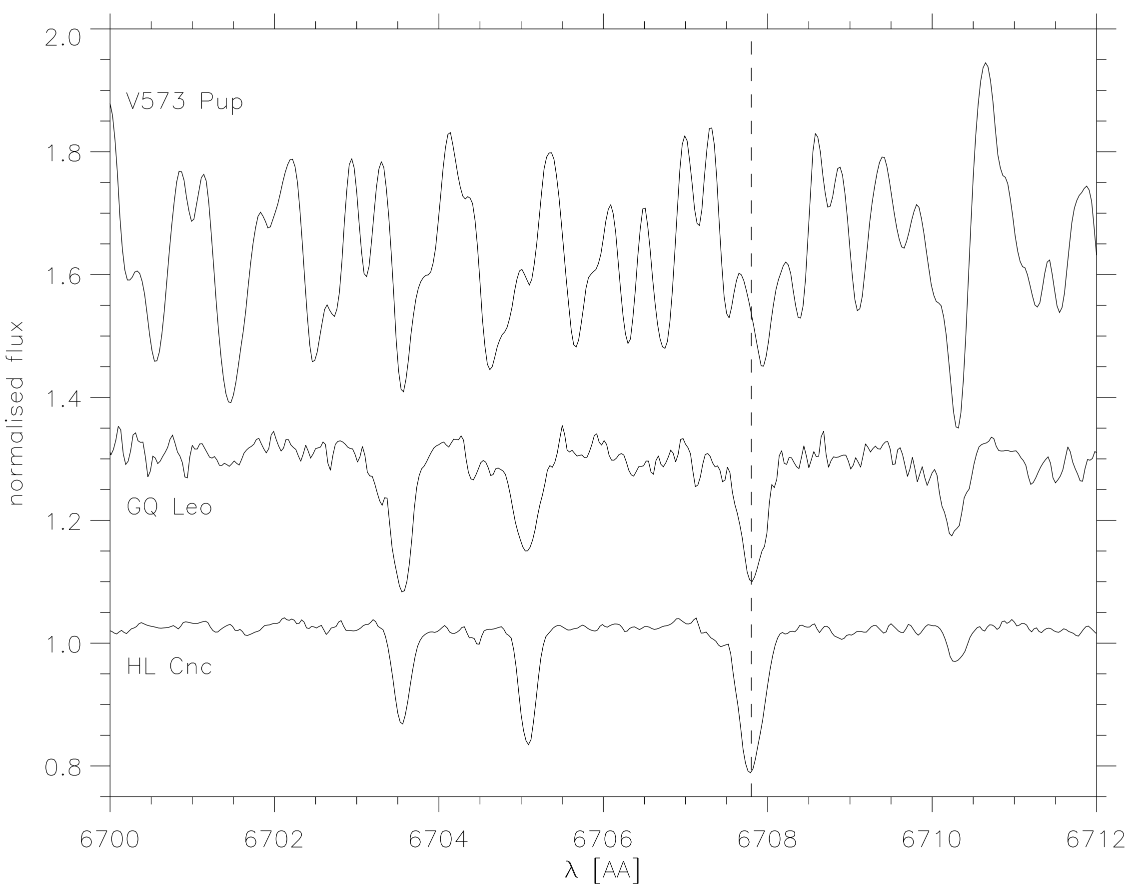

Figure 5. The region around the Li I line at 6707 Å (position marked by the dashed line). The line is present in HL Cnc and GQ Leo , while in V573 Pup the spectral region is dominated by molecular bands making interpretation difficult.

Hence the assessment of Lebzelter of HL Cnc as a solar twin was indeed quite accurate. For GQ Leo the scatter is much larger due to the low S/N spectrum, and we find $T_{eff} = 4370\,K \pm 300\,K$, which is consistent with classifying the star as a K4 dwarf, although the temperature together with the youth indicates a somewhat later spectral type. Since V573 Pup is outside the valid range of the calibrations of Kovtyukh et al. we do not attempt to refine the classification. It is clearly a M-star with strong molecular absorption bands.

In conclusion, we have shown that all three objects are active late-type stars and we have refined the classifications for HL Cnc and GQ Leo. Based on the emission properties, the youth and the spectral types we conclude that the three stars examined here can consistently be classified as BY Dra variables.

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HU ISSN 0374 – 0676

LIGHT CURVES FOR RECENT MAGELLANIC CLOUD NOVAE

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Since the beginning of 1990, 12 classical novae have been discovered in the Large Magellanic Cloud (LMC) and 7 in the Small Magellanic Cloud (SMC). Three of the LMC novae, 1996, 1997 and 1999; and the 5 in the SMC, 1996, 1998, 1999a, 1999b and 1999c; were found with the MACHO, EROS2 and OGLEII gravitational lensing surveys.

Of the remaining 11 novae, all but one, McNaught's NLMC 1990a, were discovered in Viña del Mar. Light curves for two of these have been published elsewhere: NLMC 1991 (Della Valle 1991) and the probable nova NLMC 2001 (Liller & Morel 2002). A full list of the novae and their locations appear in Shida & Liller (2004).

At the urging of Dr. Nikolai Samus, we are publishing herewith the light curves of the remaining nine novae for which much of the data, many of them ours, have not appeared elsewhere. The accompanying figures plot both calendar dates and modified Julian dates (J.D. *minus* 2,440,000), and magnitudes measured in various ways, as indicated in the figures, and reduced, as best we can, to the V system. We note that the photored (Kodak TP film) and CCD data include the usually strong Hα emission; the V and y systems do not. Most visual observers, it should be noted, have a small amount of sensitivity to Hα. When significant, "fainter than" magnitudes are indicated with a "v" and refer always to the photored values.

An analysis of these and the light curves of all other novae in the two Clouds will appear elsewhere; a preliminary report appears in Liller & Shida (2004). Not included is the light curve of the LMC nova discovered in October, 2004 (= YY Dor).

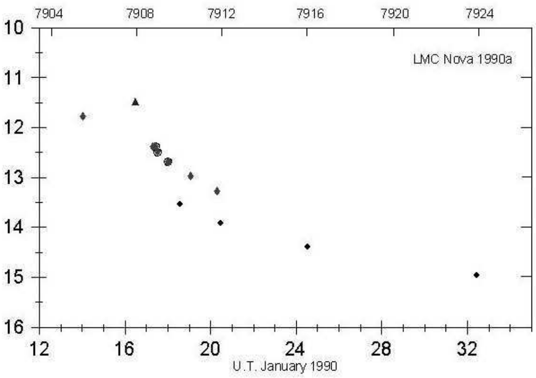

Figure 1. Light curve for Nova LMC 1990a

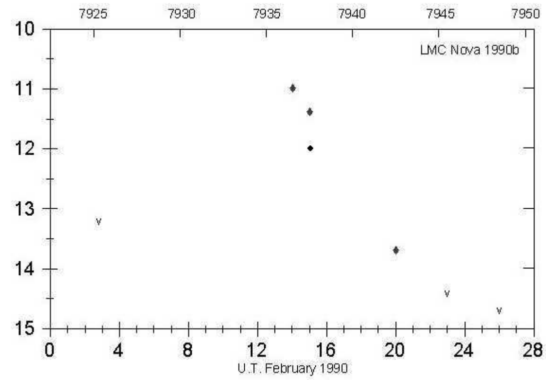

Figure 2. Light curve for Nova LMC 1990b

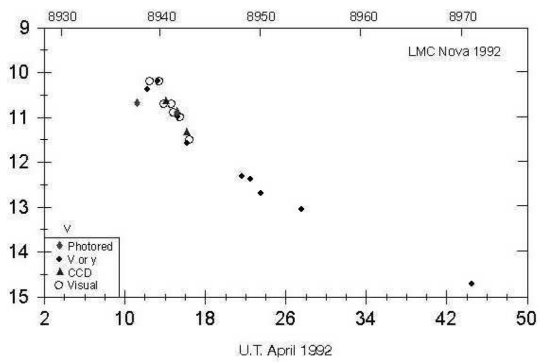

Figure 3. Light curve for Nova LMC 1992

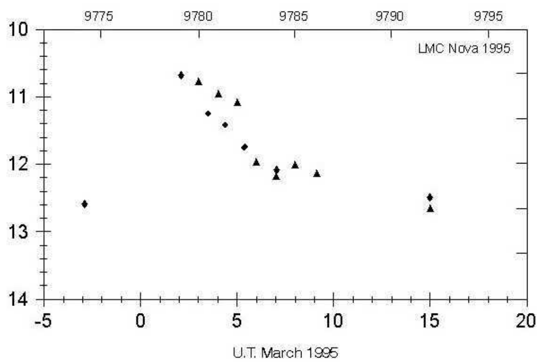

Figure 4. Light curve for Nova LMC 1995

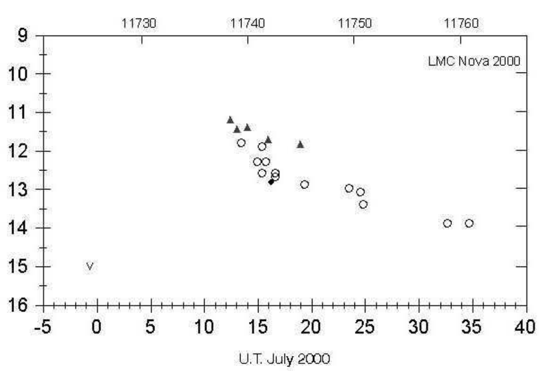

Figure 5. Light curve for Nova LMC 2000

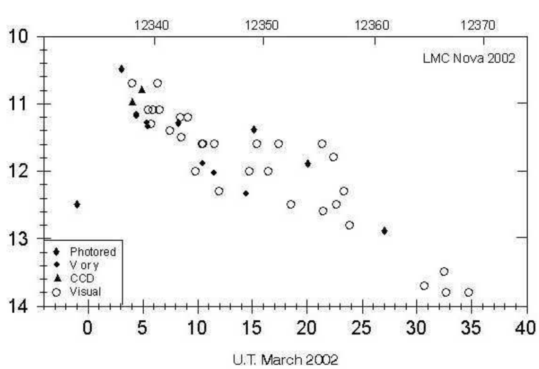

Figure 6. Light curve for Nova LMC 2002

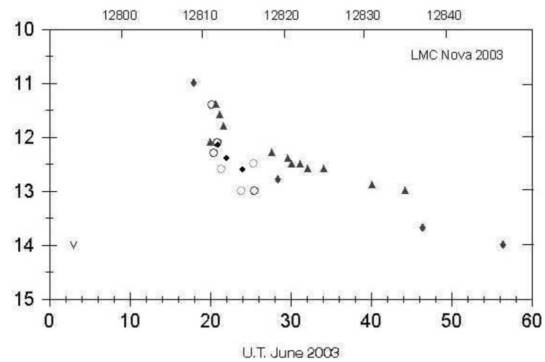

Figure 7. Light curve for Nova LMC 2003

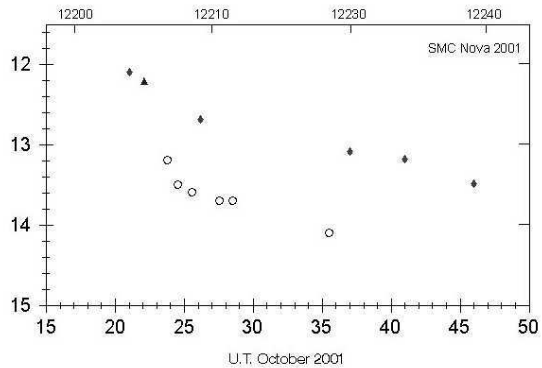

Figure 8. Light curve for Nova SMC 2001

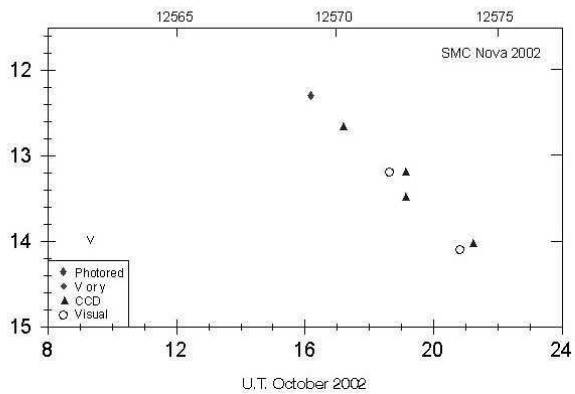

Figure 9. Light curve for Nova SMC 2002

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Shida, R.Y. & Liller, W., 2004, *ASP Conf. Series*, **310**, 184, Variable Stars in the Local Group

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CCD TIMES OF MINIMA OF SELECTED ECLIPSING BINARIES

ZEJDA, MILOSLAV

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e-mail: zejda@hvezdarna.cz

Observatory and telescope:
N. Copernicus Observatory and Planetarium in Brno – 16″ Newtonian telescope (f/1750 mm) (RL400) – 3″ refractor (f/340 mm)(RF80) Vyškov observatory (part of N. Copernicus Observatory and Planetarium in Brno) – 12″ Newtonian telescope (RL300)

Detector:	765 × 510+ SBIG ST7 CCD camera (RL400 and RL300) 1530 × 1020+ SBIG ST8 CCD camera (RF80)

Method of data reduction:
Reduction of the CCD frames was made with a software package C-Munipack [1] .

Method of minimum determination:
The minima times were computed using several procedures written by A. Gaspani (1995) based on artificial neural networks.

Times of minima:

Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
AB And	52492.4235	0.0010	I	R	MZ; RF80
AB And	52505.5330	0.0011	II	R	MZ; RF80
AB And	52504.5390	0.0012	II	R	MZ; RF80
AB And	52507.5250	0.0013	II	R	MZ; RF80
AB And	52655.3819	0.0013	I	R	MZ; RF80
DO And	52901.6090	0.0032	I	R	MZ; RL400
FK And	51924.3545	0.0069	I	C	MZ; RL400; normal
GZ And	52145.5392	0.0018	II	R	MZ; RL400
GZ And	52941.4809	0.0020	I	I	MZ; RL400
GZ And	52941.4810	0.0020	I	V	MZ; RL400
GZ And	52941.4812	0.0019	I	R	MZ; RL400
GZ And	52941.3279	0.0019	II	R	MZ; RL400
GZ And	52941.3283	0.0019	II	V	MZ; RL400
GZ And	52941.3281	0.0020	II	I	MZ; RL400

[1] Motl, D., 2004, C-Munipack, `http://integral.sci.muni.cz/cmunipack/`

Times of minima:					
Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
GZ And	52982.5053	0.0020	II	V	MZ; RL400
GZ And	52982.5054	0.0019	II	I	MZ; RL400
GZ And	52982.5049	0.0020	II	R	MZ; RL400
GZ And	53000.5011	0.0011	II	R	MZ; RL400
GZ And	53000.5017	0.0011	II	I	MZ; RL400
GZ And	53000.5016	0.0012	II	V	MZ; RL400
LM And	52901.5767	0.0028	I	R	MZ; RL400
LO And	52901.6184	0.0022	I	R	MZ; RL400
LT Aql	52437.4401	0.0052	I	C	MZ; RL400; normal
V407 Aql	52495.4810	0.0037	I	C	MZ; RL400
V415 Aql	52002.5857	0.0043	I	C	MZ; RL400
V415 Aql	52145.4240	0.0028	I	C	MZ; RL400
V479 Aql	52504.5063	0.0058	I	C	MZ; RL400
V737 Aql	52859.4332	0.0040	I	C	MZ; RL400
V760 Aql	52504.4680	0.0029	I	C	MZ; RL400
V761 Aql	52139.4160	0.0049	I	C	MZ; RL400
V761 Aql	52495.5089	0.0047	I	C	MZ; RL400
V761 Aql	52878.3351	0.0025	I	C	MZ; RL400; normal
V770 Aql	52133.5417	0.0015	I	C	MZ; RL400
V770 Aql	52141.5059	0.0059	I	V	MZ; RL400
V770 Aql	52141.5040	0.0057	I	R	MZ; RL400
V770 Aql	52141.5047	0.0056	I	C	MZ; RL400
V770 Aql	52877.4324	0.0025	I	R	MZ; RL400
V770 Aql	52877.4326	0.0025	I	V	MZ; RL400
V770 Aql	52877.4318	0.0024	I	C	MZ; RL400
V784 Aql	52141.4645	0.0021	I	C	MZ; RL400
V784 Aql	52141.4651	0.0021	I	R	MZ; RL400
V784 Aql	52141.4624	0.0055	I	V	MZ; RL400
V784 Aql	52898.4117	0.0045	I	I	MZ; RL400
V784 Aql	52898.4118	0.0045	I	V	MZ; RL400
V784 Aql	52898.4119	0.0044	I	R	MZ; RL400
V917 Aql	51777.3635	0.0040	I	C	MZ; RL400
V919 Aql	52138.3664	0.0040	I	C	MZ; RL400
V1168 Aql	52138.5112	0.0025	I	C	MZ; RL400
V1168 Aql	52147.4187	0.0020	I	C	MZ; RL400
V1341 Aql	52147.3672	0.0046	II	C	MZ; RL400
V1341 Aql	52440.4354	0.0049	II	C	MZ; RL400
V1341 Aql	52504.4277	0.0034	I	C	MZ; RL400
V1341 Aql	52859.5159	0.0022	I	C	MZ; RL400
V1341 Aql	52859.3619	0.0022	II	C	MZ; RL400
BF Aur	52274.5611	0.0050	I	R	MZ; RF80+RL400; normal
BF Aur	52279.3012	0.0017	I	R	MZ; RL400
II Aur	53029.4374	0.0049	I	C	MZ; RL400
IZ Aur	52274.4748	0.0041	I	R	MZ; RL400
LV Aur	51985.5093	0.0049	I	C	MZ; RL400; normal
MO Aur	52696.4068	0.0044	I	C	MZ; RL400
MO Aur	53028.2109	0.0056	I	C	MZ; RL400; normal
V523 Aur	53109.3795	0.0018	I	V	MZ; RL400
V523 Aur	53109.3795	0.0017	I	R	MZ; RL400
V523 Aur	53110.3709	0.0025	I	R	MZ; RL400
V523 Aur	53110.3720	0.0026	I	V	MZ; RL400
SU Boo	52730.3934	0.0053	I	R	MZ; RL400
TU Boo	52362.5021	0.0035	II	R	MZ; RL400
TU Boo	52730.4029	0.0048	II	R	MZ; RL400
ZZ Boo	52767.4833	0.0016	I	R	MZ; RF80
AC Boo	51965.6506	0.0016	II	C	MZ; RL400
AC Boo	52062.3969	0.0025	I	C	MZ; RL400; normal

Times of minima:

Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
AQ Boo	52730.4004	0.0059	I	R	MZ; RL400
AR Boo	51965.4811	0.0022	I	C	MZ; RL400
AR Boo	51965.6553	0.0053	II	C	MZ; RL400
AR Boo	52062.3879	0.0057	I	C	MZ; RL400; normal
AR Boo	52365.5369	0.0032	I	R	MZ; RL400
AR Boo	52730.4160	0.0049	I	R	MZ; RL400
EF Boo	52440.5157	0.0014	I	V	MZ; RF80
EF Boo	53029.6537	0.0018	I	R	MZ; RF80
EF Boo	53056.5664	0.0013	I	R	MZ; RF80
FY Boo	52745.4048	0.0031	II	I	MZ; RL400
FY Boo	52745.4035	0.0031	II	R	MZ; RL400
FY Boo	52745.4063	0.0031	II	V	MZ; RL400
FY Boo	52745.5246	0.0031	I	V	MZ; RL400
FY Boo	52745.5246	0.0031	I	I	MZ; RL400
FY Boo	52745.5254	0.0031	I	R	MZ; RL400
FY Boo	52767.3495	0.0031	II	R	MZ; RL400
FY Boo	52767.3499	0.0031	II	I	MZ; RL400
FY Boo	52767.3500	0.0030	II	V	MZ; RL400
FY Boo	52767.4705	0.0032	I	V	MZ; RL400
FY Boo	52767.4711	0.0032	I	I	MZ; RL400
FY Boo	52767.4712	0.0032	I	R	MZ; RL400
FY Boo	53156.4594	0.0022	I	R	MZ; RL400
FY Boo	53156.4590	0.0022	I	I	MZ; RL400
FY Boo	53156.4595	0.0021	I	V	MZ; RL400
FY Boo	53156.3395	0.0019	II	V	MZ; RL400
FY Boo	53156.3391	0.0011	II	I	MZ; RL400
FY Boo	53156.3390	0.0011	II	R	MZ; RL400
44i Boo	52365.6019	0.0015	II	V	MZ; RF80
44i Boo	53083.6254	0.0050	II	R	MZ; RF80
AZ Cam	53028.5207	0.0023	I	R	MZ; RF80
WX Cnc	52730.3356	0.0042	I	R	MZ; RL400
AO Cnc	52723.3600	0.0053	I	R	MZ; RL400
EH Cnc	52279.5445	0.0041	I	C	MZ; RL400
EH Cnc	52730.3969	0.0052	II	R	MZ; RL400
GQ Cnc	52279.6194	0.0056	II	C	MZ; RL400
CI CVn	52697.3768	0.0012	I	R	MZ; RF80
CI CVn	52745.5142	0.0009	I	I	MZ; RF80
R CMa	52695.3903	0.0035	I	R	MZ; RF80
FZ CMa	53056.4195	0.0048	I	R	MZ; RF80
TU CMi	51580.4719	0.0047	I	C	MZ; RL400; normal
TU CMi	51965.3588	0.0030	I	C	MZ; RL400
TU CMi	52002.4149	0.0020	II	C	MZ; RL400; normal
TU CMi	52279.6072	0.0043	I	R	MZ; RL400
TU CMi	52279.6060	0.0050	I	C	MZ; RL400
TU CMi	52362.3940	0.0056	I	C	MZ; RL400
TU CMi	52367.3786	0.0033	II	R	MZ; RL400
TU CMi	52367.3743	0.0034	II	C	MZ; RL400
TU CMi	52369.3248	0.0093	I	V	MZ; RL400
TU CMi	52369.3290	0.0038	I	R	MZ; RL400
TU CMi	52369.3261	0.0039	I	C	MZ; RL400
TU CMi	52668.4031	0.0065	I	R	MZ; RL400
TU CMi	52668.4037	0.0063	I	I	MZ; RL400
TU CMi	52668.4000	0.0061	I	V	MZ; RL400
TX CMi	51876.5559	0.0042	I	C	MZ; RL400; normal
TX CMi	51965.2990	0.0018	I	C	MZ; RL400
TX CMi	51985.3428	0.0039	II	C	MZ,KK; RL400+RL300; normal
TX CMi	51924.4321	0.0012	I	C	MZ; RL400
TX CMi	52279.5917	0.0054	II	C	MZ; RL400
TX CMi	52279.5915	0.0022	II	R	MZ; RL400

Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
Times of minima:					
TX CMi	52362.3002	0.0014	I	C	MZ; RL400
TX CMi	52367.3610	0.0042	I	C	MZ; RL400
TX CMi	52367.3614	0.0022	I	R	MZ; RL400
TX CMi	52369.3125	0.0068	I	C	MZ; RL400; normal
TX CMi	52369.3036	0.0056	I	R	MZ; RL400; normal
TX CMi	52668.4196	0.0058	II	R	MZ; RL400
TX CMi	52668.4205	0.0056	II	I	MZ; RL400
TX CMi	52668.4219	0.0055	II	V	MZ; RL400
TX CMi	52668.2266	0.0060	I	V	MZ; RL400; normal
TX CMi	52668.2263	0.0061	I	I	MZ; RL400; normal
TX CMi	52668.2264	0.0038	I	R	MZ; RL400; normal
TX CMi	53000.4215	0.0038	II	R	MZ; RL400
TX CMi	53000.4210	0.0037	II	V	MZ; RL400
XZ CMi	52362.2912	0.0019	I	C	MZ; RL400
YY CMi	52672.5204	0.0055	I	R	MZ; RL400
BF CMi	52683.3959	0.0051	I	R	MZ; RF80
AL Cas	52274.5048	0.0033	I	C	MZ; RL400; normal
GH Cas	51467.3204	0.0032	I	C	MZ; RL400
IR Cas	52145.5187	0.0015	I	R	MZ; RL400
IR Cas	52908.5656	0.0015	I	R	MZ; RL400
MR Cas	52213.4621	0.0053	I	R	MZ; RL400
MR Cas	52684.3637	0.0055	I	R	MZ; RL400
MT Cas	52684.3376	0.0056	I	R	MZ; RL400
MT Cas	52879.5725	0.0033	I	R	MZ; RL400
NT Cas	52213.5139	0.0073	I	R	MZ; RL400
NV Cas	52147.5642	0.0032	I	R	MZ; RL400
V336 Cas	52684.3732	0.0046	I	C	MZ; RL400
V360 Cas	52213.5299	0.0024	I	R	MZ; RL400
V380 Cas	52367.4357	0.0046	I	C	MZ; RL400; normal
V473 Cas	52684.2777	0.0039	I	R	MZ; RL400
V523 Cas	52684.2889	0.0016	I	R	MZ; RL400
V523 Cas	52864.3501	0.0048	II	I	MZ; RL400
V523 Cas	52864.4664	0.0050	I	I	MZ; RL400
V651 Cas	52908.5836	0.0040	I	R	MZ; RL400
SU Cep	53070.4915	0.0040	II	R	MZ; RF80
WX Cep	52864.4952	0.0043	II	I	MZ; RL400
WX Cep	52908.4166	0.0051	II	V	MZ; RL400
WX Cep	52908.4167	0.0051	II	R	MZ; RL400
WX Cep	52908.4199	0.0051	II	I	MZ; RL400
XX Cep	52861.4763	0.0028	I	I	MZ; RF80
XY Cep	52908.3845	0.0046	I	R	MZ; RL400
AI Cep	53070.4803	0.0026	II	R	MZ; RF80
CM Cep	52879.5442	0.0025	I	R	MZ; RL400
EK Cep	52868.5561	0.0040	II	I	MZ; RF80
EK Cep	52908.4062	0.0050	II	R	MZ; RL400
EK Cep	52908.4074	0.0046	II	I	MZ; RL400
EK Cep	52908.4078	0.0051	II	V	MZ; RL400
GI Cep	52908.5706	0.0037	I	R	MZ; RL400
IW Cep	52105.4934	0.0022	I	R	MZ; RL400; normal
IW Cep	52908.5974	0.0044	I	V	MZ; RL400
LP Cep	52133.3920	0.0055	I	C	MZ; RL400; normal
MT Cep	52908.6117	0.0036	I	R	MZ; RL400
OT Cep	52908.6019	0.0043	I	R	MZ; RL400
V338 Cep	52860.5594	0.0014	I	I	MZ; RF80
V357 Cep	52908.3174	0.0029	I	R	MZ; RL400
V358 Cep	52879.5741	0.0038	I	R	MZ; RL400
V358 Cep	52908.4173	0.0038	I	R	MZ; RL400

Times of minima:

Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
42731306 Cep	53109.4969	0.0103	I	R	MZ; RF80; new var.
42880186 Cep	52864.3626	0.0019	I	I	MZ; RL400
42880186 Cep	52864.3621	0.0028	I	V	MZ; RL400
42880186 Cep	52864.3630	0.0028	I	R	MZ; RL400
XY Cet	52279.2978	0.0032	I	R	MZ; RL400
XY Cet	52949.4487	0.0025	I	R	MZ; RF80
RW Com	51985.4512	0.0015	II	C	MZ; RL400; normal
RW Com	52039.4477	0.0037	I	C	MZ; RL400; normal
RZ Com	53028.6036	0.0030	II	R	MZ; RL400
RZ Com	53083.4421	0.0020	II	I	MZ; RL400
RZ Com	53083.4422	0.0021	II	R	MZ; RL400
RZ Com	53083.4425	0.0020	II	V	MZ; RL400
RZ Com	53083.6132	0.0021	I	V	MZ; RL400
RZ Com	53083.6118	0.0021	I	R	MZ; RL400
RZ Com	53083.6129	0.0021	I	I	MZ; RL400
CC Com	52002.3484	0.0028	I	C	MZ; RL400; normal
CC Com	52002.4592	0.0016	II	C	MZ; RL400; normal
CC Com	52039.4238	0.0026	I	C	MZ; RL400
CN Com	51965.5280	0.0047	I	C	MZ; RL400
EK Com	53028.5788	0.0028	I	R	MZ; RL400
EK Com	53028.7117	0.0022	II	R	MZ; RL400
EK Com	53029.6456	0.0035	I	R	MZ; RL400
EQ Com	53028.5705	0.0026	I	R	MZ; RL400
EQ Com	53029.6558	0.0044	I	R	MZ; RL400
LL Com	52730.4270	0.0047	I	R	MZ; RL400
RW CrB	52002.3701	0.0047	I	C	MZ; RL400
RW CrB	52023.4368	0.0032	I	C	MZ; RL400
RW CrB	52039.4183	0.0015	I	C	MZ; RL400
TU CrB	52031.2855	0.0060	I	C	MZ; RL400; normal
TU CrB	52039.3575	0.0019	I	C	MZ; RL400
TU CrB	52105.5155	0.0057	I	V	MZ; RL400
TU CrB	52105.5157	0.0068	I	R	MZ; RL400
TU CrB	52105.5164	0.0033	I	C	MZ; RL400
TU CrB	52139.4019	0.0062	I	R	MZ; RL400
TU CrB	52139.4019	0.0062	I	C	MZ; RL400
TU CrB	52694.4875	0.0030	I	C	MZ; RL400
TU CrB	52694.4878	0.0029	I	I	MZ; RL400
TU CrB	52694.4879	0.0030	I	R	MZ; RL400
TU CrB	52694.4887	0.0028	I	V	MZ; RL400
TU CrB	52723.5326	0.0041	I	V	MZ; RL400
TU CrB	52723.5330	0.0041	I	R	MZ; RL400
TU CrB	52723.5334	0.0041	I	I	MZ; RL400
TU CrB	52723.5327	0.0040	I	C	MZ; RL400
TU CrB	52765.4874	0.0015	I	I	MZ; RL400
TU CrB	52765.4875	0.0016	I	R	MZ; RL400
TU CrB	52765.4876	0.0016	I	V	MZ; RL400
TU CrB	52832.4620	0.0070	II	R	MZ; RL400
TU CrB	52832.4608	0.0070	II	C	MZ; RL400
TU CrB	52832.4589	0.0057	II	I	MZ; RL400
TU CrB	53124.5359	0.0094	II	R	MZ; RL400
TU CrB	53124.5263	0.0079	II	C	MZ; RL400
TW CrB	52147.3621	0.0013	I	R	MZ; RL400
W Crv	52367.5164	0.0030	I	C	MZ; RL400
EE Cyg	52815.4864	0.0054	I	R	MZ; RL400
GV Cyg	52949.3279	0.0022	I	R	MZ; RL400
LN Cyg	52815.5125	0.0037	I	R	MZ; RL400
QS Cyg	51467.3427	0.0060	I	C	MZ; RL400
QS Cyg	51776.3569	0.0042	I	C	MZ; RL400

Times of minima:					
Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
QU Cyg	52440.4657	0.0041	I	C	MZ; RL400
QU Cyg	52507.5948	0.0011	II	C	MZ; RL400
QU Cyg	52507.4236	0.0026	I	C	MZ; RL400
QU Cyg	52512.4530	0.0048	II	C	MZ; RL400
QU Cyg	52931.3460	0.0056	I	C	MZ; RL400; normal
QX Cyg	52440.4817	0.0024	I	C	MZ; RL400
QX Cyg	52507.4988	0.0085	II	C	MZ; RL400
V388 Cyg	52836.4225	0.0021	I	I	MZ; RF80
V388 Cyg	52875.5090	0.0023	II	R	MZ; RF80
V388 Cyg	52900.4266	0.0018	II	R	MZ; RF80
V442 Cyg	52875.4925	0.0020	II	R	MZ; RF80
V442 Cyg	52900.5454	0.0023	I	R	MZ; RF80
V680 Cyg	52507.5615	0.0040	II	R	MZ; RL400
V689 Cyg	52440.4674	0.0027	I	C	MZ; RL400
V689 Cyg	52507.4111	0.0014	I	C	MZ; RL400
V711 Cyg	52133.3999	0.0015	I	C	MZ; RL400
V711 Cyg	52815.4347	0.0058	I	R	MZ; RL400
V711 Cyg	52901.4130	0.0044	I	I	MZ; RL400; normal
V711 Cyg	52949.3626	0.0045	I	R	MZ; RL400
V822 Cyg	52437.4431	0.0020	I	C	MZ; RL400
V836 Cyg	52854.5337	0.0014	I	I	MZ; RF80
V869 Cyg	52145.3658	0.0069	I	C	MZ; RL400; normal
V907 Cyg	52440.4012	0.0042	I	R	MZ; RL400
V907 Cyg	52440.4012	0.0042	I	R	MZ; RL400
V947 Cyg	52507.4090	0.0043	I	C	MZ; RL400
V961 Cyg	52031.4614	0.0071	I	C	MZ; RL400
V965 Cyg	51040.3915	0.0065	I	C	MZ; RL400; normal
V1414 Cyg	52815.5023	0.0057	I	R	MZ; RL400
V1723 Cyg	52097.3946	0.0036	I	R	MZ; RL400
V1787 Cyg	52507.4409	0.0027	I	R	MZ; RL400
V1856 Cyg	52815.4998	0.0041	I	R	MZ; RL400
V1856 Cyg	52901.4621	0.0039	I	R	MZ; RL400
V1908 Cyg	52437.4576	0.0021	I	C	MZ; RL400
V2239 Cyg	52145.4678	0.0024	I	C	MZ; RL400
V2240 Cyg	52145.4316	0.0049	I	C	MZ; RL400
V2280 Cyg	52139.5379	0.0039	II	R	MZ; RL400
V2284 Cyg	53148.5301	0.0023	I	R	MZ; RL400
V2284 Cyg	53148.5300	0.0024	I	I	MZ; RL400
V2284 Cyg	53148.5308	0.0023	I	V	MZ; RL400
26851186 Cyg	52875.5524	0.0043	I	R	MZ; RF80; new var.
26851186 Cyg	52900.4663	0.0024	I	R	MZ; RF80; new var.
AV Del	52105.4476	0.0021	I	R	MZ; RL400
BH Del	52133.4617	0.0044	I	C	MZ; RL400
TW Dra	52694.4083	0.0006	I	I	MZ; RF80
TW Dra	52983.5185	0.0019	I	I	MZ; RF80
TW Dra	53070.5297	0.0027	I	R	MZ; RL400
TW Dra	53070.5298	0.0027	I	I	MZ; RL400
TW Dra	53070.5287	0.0027	I	V	MZ; RL400
FU Dra	52002.5086	0.0035	II	V	MZ; RL400
FU Dra	52023.5219	0.0070	I	V	MZ; RL400
FU Dra	52062.4734	0.0031	I	V	MZ; RL400
FU Dra	52039.4701	0.0060	I	V	MZ; RL400
FU Dra	52730.5016	0.0035	I	R	MZ; RF80
FU Dra	52983.5459	0.0013	I	I	MZ; RF80
FU Dra	52983.3930	0.0011	II	I	MZ; RF80

Times of minima:

Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
KZ Dra	52861.4846	0.0028	I	I	MZ; RL400
KZ Dra	52861.4846	0.0027	I	V	MZ; RL400
KZ Dra	52861.4847	0.0027	I	R	MZ; RL400
YY Eri	52898.6441	0.0006	I	R	MZ; RF80
TX Gem	53000.5576	0.0023	I	R	MZ; RL400
AY Gem	53029.3764	0.0062	I	R	MZ; RL400
BT Gem	51965.3112	0.0021	I	C	MZ; RL400; normal
CK Gem	52696.3890	0.0025	I	R	MZ; RL400
EL Gem	52369.3758	0.0018	I	R	MZ; RL400
EL Gem	52694.3208	0.0043	II	C	MZ; RL400
EL Gem	53029.2601	0.0029	I	R	MZ; RL400
FG Gem	53029.4400	0.0044	I	R	MZ; RL400
FO Gem	51924.4997	0.0022	I	C	MZ; RL400
FO Gem	52697.3773	0.0036	I	C	MZ; RL400
FT Gem	53029.3280	0.0055	I	R	MZ; RL400
KQ Gem	51924.4045	0.0061	I	C	MZ; RL400; normal
KQ Gem	52683.2666	0.0060	I	R	MZ; RL400
KQ Gem	52683.4675	0.0059	II	R	MZ; RL400
KQ Gem	52697.3426	0.0030	II	R	MZ; RL400
KV Gem	51924.5744	0.0014	I	C	MZ; RL400
KV Gem	51924.3957	0.0020	II	C	MZ; RL400
KV Gem	51965.4456	0.0054	I	C	MZ; RL400
KV Gem	51965.2690	0.0065	II	C	MZ; RL400
KV Gem	52234.6979	0.0016	I	C	MZ; RL400
KV Gem	52234.6982	0.0016	I	R	MZ; RL400
KV Gem	52234.6975	0.0028	I	V	MZ; RL400
KV Gem	52683.3904	0.0040	II	R	MZ; RL400
KV Gem	52683.3903	0.0041	II	V	MZ; RL400
KV Gem	52696.4765	0.0028	I	R	MZ; RL400
KV Gem	52696.4772	0.0029	I	V	MZ; RL400
KV Gem	52697.3723	0.0030	II	R	MZ; RL400
KV Gem	52697.3730	0.0038	II	V	MZ; RL400
KV Gem	52721.3942	0.0021	II	R	MZ; RL400
KV Gem	52721.3946	0.0021	II	V	MZ; RL400
KV Gem	52722.2900	0.0016	I	V	MZ; RL400
KV Gem	52722.2894	0.0017	I	R	MZ; RL400
KV Gem	52723.3653	0.0043	I	R	MZ; RL400
KV Gem	52723.3661	0.0041	I	V	MZ; RL400
KV Gem	52734.3006	0.0042	II	R	MZ; RL400
KV Gem	52734.3000	0.0022	II	I	MZ; RL400
KV Gem	52734.3011	0.0042	II	V	MZ; RL400
V412 Her	51982.6001	0.0039	I	C	MZ; RL400; normal
V643 Her	52002.5594	0.0019	I	C	MZ; RL400
V719 Her	51657.3973	0.0056	II	C	MZ; RL400; normal
V719 Her	51694.4829	0.0055	I	C	MZ; RL400; normal
V719 Her	51714.5339	0.0067	I	C	MZ; RL400; normal
V719 Her	51752.4178	0.0049	II	C	MZ; RL400; normal
V719 Her	51965.7119	0.0042	II	C	MZ; RL400; normal
V719 Her	51982.5513	0.0034	II	C	MZ; RL400
V719 Her	52002.5959	0.0016	II	C	MZ; RL400
V719 Her	52031.4728	0.0028	II	C	MZ; RL400
V719 Her	52828.5028	0.0043	II	R	MZ; RL400
V789 Her	52002.5082	0.0085	II	R	MZ; RL400
V789 Her	52023.4681	0.0053	I	R	MZ; RL400
V789 Her	52031.4728	0.0021	I	R	MZ; RL400
V789 Her	52039.4715	0.0062	I	R	MZ; RL400
V789 Her	52097.3996	0.0037	I	R	MZ; RL400
V789 Her	52134.3627	0.0029	II	V	MZ; RL400
V789 Her	52134.3641	0.0030	II	R	MZ; RL400

Times of minima:					
Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
V789 Her	52145.4013	0.0109	I	R	MZ; RL400
V789 Her	52367.5189	0.0035	I	R	MZ; RL400
V789 Her	52369.5971	0.0052	II	V	MZ; RL400
V789 Her	52398.5581	0.0030	I	V	MZ; RL400
V789 Her	52398.5585	0.0032	I	R	MZ; RL400
V789 Her	52427.5224	0.0048	II	R	MZ; RL400
V789 Her	52427.5232	0.0045	II	V	MZ; RL400
V789 Her	52696.6763	0.0020	II	V	MZ; RL400
V789 Her	52696.6769	0.0017	II	R	MZ; RL400
V789 Her	52697.6395	0.0041	II	V	MZ; RL400
V789 Her	52697.6379	0.0037	II	R	MZ; RL400
V789 Her	52886.3012	0.0041	I	I	MZ; RL400
V789 Her	52886.3019	0.0021	I	R	MZ; RL400
V789 Her	53082.4898	0.0025	I	I	MZ; RL400
V789 Her	53082.4878	0.0024	I	R	MZ; RL400
V789 Her	53082.4878	0.0036	I	V	MZ; RL400
V789 Her	53082.6513	0.0058	II	V	MZ; RL400
V789 Her	53082.6513	0.0057	II	R	MZ; RL400
V1005 Her	52410.3573	0.0028	I	R	MZ; RL400
V1005 Her	52427.3746	0.0030	I	R	MZ; RL400
CU Hya	53056.3731	0.0019	I	R	MZ; RL400
EU Hya	52279.5877	0.0039	I	C	MZ; RL400; normal
V390 Hya	53082.3909	0.0025	I	C	MZ; RL400
VY Lac	52901.4741	0.0009	I	I	MZ; RL400
AR Lac	52941.4498	0.0016	I	R	MZ; RF80
AU Lac	52901.4751	0.0037	I	I	MZ; RL400
CF Lac	52507.4537	0.0060	I	R	MZ; RL400
NS Lac	52062.3837	0.0061	I	C	MZ; RL400; normal
PP Lac	51841.3114	0.0020	II	C	MZ; RL400
PP Lac	51841.5139	0.0047	I	C	MZ; RL400
V339 Lac	52023.5171	0.0025	I	C	MZ; RL400; normal
V339 Lac	52507.5313	0.0028	I	R	MZ; RL400
V344 Lac	52872.3921	0.0029	I	I	MZ; RL400
V344 Lac	52872.3917	0.0030	I	R	MZ; RL400
V344 Lac	52872.3917	0.0029	I	V	MZ; RL400
V344 Lac	52875.5309	0.0034	I	I	MZ; RL400
V344 Lac	52875.5299	0.0033	I	V	MZ; RL400
V344 Lac	52875.5298	0.0035	I	R	MZ; RL400
Y Leo	52725.4855	0.0018	I	C	MZ; RL400
RW Leo	53029.6429	0.0049	I	R	MZ; RL400
UV Leo	52672.6603	0.0015	II	I	MZ; RF80
UV Leo	52949.6008	0.0013	I	R	MZ; RF80
UV Leo	53068.4187	0.0017	I	R	MZ; RF80
UX Leo	53029.6057	0.0037	I	R	MZ; RL400
BL Leo	51965.6855	0.0012	I	C	MZ; RL400; normal
BL Leo	51965.5442	0.0018	II	C	MZ; RL400
BL Leo	52367.4339	0.0022	I	C	MZ; RL400
BL Leo	52367.5735	0.0041	II	C	MZ; RL400
BL Leo	52672.6227	0.0037	II	R	MZ; RL400
BL Leo	52672.6231	0.0041	II	V	MZ; RL400
BL Leo	52684.4648	0.0019	II	R	MZ; RL400
BL Leo	52684.4648	0.0034	II	V	MZ; RL400
BW Leo	51608.4671	0.0036	II	C	MZ; RL400; normal
BW Leo	51626.5129	0.0041	I	C	MZ; RL400; normal
BW Leo	51685.3855	0.0032	II	C	MZ; RL400; normal
BW Leo	51965.4073	0.0058	II	C	MZ; RL400; normal
BW Leo	51965.5761	0.0018	I	C	MZ; RL400
BW Leo	52367.3870	0.0046	I	C	MZ; RL400

Times of minima:

Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
BW Leo	52367.5551	0.0045	II	C	MZ; RL400
BW Leo	52723.3120	0.0090	I	R	MZ; RL400
BW Leo	52730.3948	0.0045	I	R	MZ; RL400
BW Leo	52730.3965	0.0053	I	V	MZ; RL400
CE Leo	52725.3939	0.0015	I	C	MZ; RL400
CE Leo	52730.3996	0.0047	II	R	MZ; RL400
T LMi	51965.5536	0.0039	I	C	MZ; RL400
Z Lep	52672.4661	0.0015	I	C	MZ; RL400; normal
RR Lep	52672.3889	0.0017	I	C	MZ; RL400
RR Lep	53029.4063	0.0040	I	R	MZ; RF80
RV Lyn	51924.2201	0.0112	I	C	MZ; RL400; normal
SW Lyn	52908.5929	0.0012	I	R	MZ; RF80
MZ Lyr	52141.4879	0.0067	I	R	MZ; RL400
PY Lyr	52505.5104	0.0026	I	V	MZ; RL400
PY Lyr	52505.5108	0.0029	I	I	MZ; RL400
PY Lyr	52505.5093	0.0029	I	R	MZ; RL400
PY Lyr	52521.5232	0.0034	II	V	MZ; RL400
PY Lyr	52521.5208	0.0020	II	I	MZ; RL400
PY Lyr	52521.5194	0.0034	II	R	MZ; RL400
PY Lyr	52721.5410	0.0030	I	V	MZ; RL400
PY Lyr	52721.5421	0.0030	I	I	MZ; RL400
PY Lyr	52721.5406	0.0030	I	R	MZ; RL400
PY Lyr	52725.5931	0.0041	II	I	MZ; RL400
PY Lyr	52725.5940	0.0033	II	R	MZ; RL400
PY Lyr	52725.5965	0.0033	II	V	MZ; RL400
PY Lyr	52809.4954	0.0029	I	R	MZ; RL400
PY Lyr	52809.4947	0.0029	I	I	MZ; RL400
PY Lyr	52809.4958	0.0029	I	V	MZ; RL400
PY Lyr	53186.3926	0.0023	I	R	MZ; RL400
PY Lyr	53186.3920	0.0023	I	I	MZ; RL400
PY Lyr	53186.3917	0.0021	I	V	MZ; RL400
V336 Lyr	52365.5586	0.0034	I	C	MZ; RL400
V361 Lyr	52002.4991	0.0016	II	R	MZ; RL400
V361 Lyr	52031.4522	0.0064	I	R	MZ; RL400
V361 Lyr	52097.3977	0.0044	I	R	MZ; RL400
V361 Lyr	52145.3907	0.0046	I	R	MZ; RL400
V361 Lyr	52147.5563	0.0035	I	R	MZ; RL400
V361 Lyr	52198.3322	0.0015	I	R	MZ; RL400
V361 Lyr	52365.5225	0.0011	I	C	MZ; RL400
V361 Lyr	52369.5499	0.0009	I	R	MZ; RL400
V361 Lyr	52730.5572	0.0018	I	R	MZ; RL400
V361 Lyr	52730.5577	0.0017	I	I	MZ; RL400
V361 Lyr	52763.5328	0.0025	II	V	MZ; RL400
V361 Lyr	52763.3771	0.0028	I	V	MZ; RL400
V361 Lyr	52763.3765	0.0028	I	R	MZ; RL400
V361 Lyr	52763.5313	0.0017	II	R	MZ; RL400
V361 Lyr	52854.5568	0.0033	II	R	MZ; RL400
V361 Lyr	52854.5568	0.0033	II	I	MZ; RL400
V361 Lyr	52854.5548	0.0033	II	V	MZ; RL400
V361 Lyr	52854.4021	0.0024	I	V	MZ; RL400
V361 Lyr	52854.4030	0.0024	I	I	MZ; RL400
V361 Lyr	52854.4030	0.0025	I	R	MZ; RL400
V361 Lyr	53110.6132	0.0015	II	R	MZ; RL400
V361 Lyr	53110.4522	0.0018	I	R	MZ; RL400
V361 Lyr	53110.4531	0.0018	I	V	MZ; RL400
V400 Lyr	52002.5877	0.0017	I	C	MZ; RL400
V412 Lyr	52138.4893	0.0046	I	C	MZ; RL400
V417 Lyr	52002.5900	0.0016	I	C	MZ; RL400

Times of minima:					
Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
V429 Lyr	52139.5572	0.0049	I	C	MZ; RL400; normal
V429 Lyr	52138.4929	0.0019	I	C	MZ; RL400
V431 Lyr	52023.6070	0.0041	I	C	MZ; RL400; normal
V431 Lyr	52141.4470	0.0082	I	R	MZ; RL400
V477 Lyr	52031.5153	0.0004	I	C	MZ; RL400
RW Mon	53000.5698	0.0028	I	R	MZ; RL400
VX Mon	53028.4259	0.0020	I	C	MZ; RL400
AO Mon	52672.4817	0.0012	II	I	MZ; RF80
AT Mon	53029.4062	0.0023	I	R	MZ; RL400
BB Mon	53029.4088	0.0026	I	R	MZ; RL400
BZ Mon	52367.3342	0.0079	I	C	MZ; RL400
CK Mon	52279.3928	0.0082	I	R	MZ; RL400
HM Mon	52279.3523	0.0024	I	R	MZ; RL400
HM Mon	52279.5569	0.0059	II	R	MZ; RL400
HM Mon	52672.3355	0.0083	I	R	MZ; RL400
HT Mon	52367.3721	0.0057	I	C	MZ; RL400; normal
IZ Mon	51965.4387	0.0111	I	C	MZ; RL400; normal
IZ Mon	53056.3761	0.0021	I	R	MZ; RL400
MX Mon	52141.5583	0.0028	I	C	MZ; RL400
V396 Mon	51876.6169	0.0041	II	C	MZ; RL400; normal
V396 Mon	53082.2785	0.0023	II	R	MZ; RL400
V453 Mon	53068.4369	0.0007	I:	R	MZ; RL400
V455 Mon	52672.3603	0.0046	I	R	MZ; RL400
V524 Mon	51965.4540	0.0064	II	C	MZ; RL400
V524 Mon	52362.3742	0.0022	I	C	MZ; RL400
V527 Mon	51965.2817	0.0050	I	C	MZ; RL400
V528 Mon	51841.5820	0.0052	I	C	MZ; RL400; normal
V532 Mon	52672.4166	0.0084	II:	R	MZ; RL400
V681 Mon	51965.3682	0.0112	I	C	MZ; RL400
V681 Mon	52322.3250	0.0051	I	C	MZ,DM,OP; RL400+RL300; normal
U Oph	53170.4468	0.0033	I	R	MZ; RF80
U Oph	53170.4467	0.0029	I	I	MZ; RF80
U Oph	53170.4450	0.0028	I	V	MZ; RF80
V501 Oph	52836.4316	0.0017	I	R	MZ; RL400
V941 Oph	52836.4296	0.0033	II	C	MZ; RL400
V981 Oph	52031.4447	0.0061	I	C	MZ; RL400
EF Ori	52279.3368	0.0050	I	C	MZ; RL400; normal
EF Ori	52360.3059	0.0037	I	C	MZ; RL400
EF Ori	52683.3943	0.0062	II	R	MZ; RL400
ER Ori	52982.4255	0.0012	I	R	MZ; RF80
ET Ori	52672.4028	0.0055	I	C	MZ; RL400
FF Ori	53028.3631	0.0051	I	I	MZ; RL400
FH Ori	53028.3630	0.0022	I	I	MZ; RL400
FR Ori	53000.5087	0.0053	I	R	MZ; RL400; normal
FZ Ori	52213.5202	0.0131	I	R	MZ; RL400
FZ Ori	53028.2907	0.0042	I	I	MZ; RL400
GU Ori	51924.3332	0.0026	I	C	MZ; RL400
GU Ori	52672.4735	0.0014	II	C	MZ; RL400
GU Ori	52683.2987	0.0039	II	R	MZ; RL400
GU Ori	52683.3004	0.0063	II	V	MZ; RL400
GU Ori	52694.3596	0.0042	I	R	MZ; RL400
GU Ori	52694.3591	0.0042	I	V	MZ; RL400
GU Ori	52695.3022	0.0030	I	R	MZ; RL400
GU Ori	52695.3015	0.0044	I	V	MZ; RL400
GU Ori	52723.3060	0.0034	II	C	MZ; RL400
GU Ori	52983.3553	0.0029	I	R	MZ; RL400
GU Ori	52983.3557	0.0029	I	I	MZ; RL400
GU Ori	52983.3561	0.0028	I	V	MZ; RL400

Times of minima:

Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
GU Ori	52983.5918	0.0030	II	V	MZ; RL400
GU Ori	52983.5916	0.0029	II	R	MZ; RL400
GU Ori	52983.5933	0.0029	II	I	MZ; RL400
OS Ori	51924.3348	0.0087	I	C	MZ; RL400; normal
QV Ori	52949.5472	0.0040	I	R	MZ; RL400
V641 Ori	52683.4155	0.0035	I	R	MZ; RL400
V641 Ori	53028.2918	0.0043	I	R	MZ; RL400
V644 Ori	53029.4681	0.0049	I	C	MZ; RL400
V645 Ori	52279.3375	0.0065	I	R	MZ; RL400
V667 Ori	51924.5545	0.0071	I	C	MZ,JŠ; RL400
BO Peg	52141.5598	0.0026		R	MZ; RL400
BX Peg	52145.5289	0.0042	II	R	MZ; RL400
BX Peg	52521.4288	0.0014	I	R	MZ; RF80
BX Peg	52521.5697	0.0017	II	R	MZ; RF80
CE Peg	52062.3874	0.0067	I	C	MZ; RL400; normal
DK Peg	52147.5209	0.0052	I	R	MZ; RL400
EU Peg	52147.5456	0.0024	I	R	MZ; RL400
GP Peg	52874.4848	0.0020	I	R	MZ; RF80
KW Peg	52521.4223	0.0044	I	R	MZ; RF80
HadV26 Peg	52982.2335	0.0012	I	R	MZ; RL400;=GSC 11291457 Peg
WY Per	52949.3897	0.0040	I	R	MZ; RL400
FW Per	52898.6081	0.0034	I	I	MZ; RL400
II Per	51924.3500	0.0027	I	C	MZ; RL400
II Per	52279.4376	0.0046	I	C	MZ; RL400; normal
II Per	52591.3426	0.0034	I	R	MZ; RL400
PS Per	52213.4662	0.0070	I	R	MZ; RL400
QT Per	52898.5838	0.0035	II	I	MZ; RL400
V432 Per	52949.4700	0.0038	II	R	MZ; RL400
V432 Per	52949.6590	0.0029	I	R	MZ; RL400
V457 Per	52274.3294	0.0063	I	R	MZ; RL400; normal
V482 Per	52949.4565	0.0053	I	R	MZ; RL400
UV Psc	52874.5968	0.0009	I	R	MZ; RL400
UV Psc	52874.5968	0.0009	I	I	MZ; RL400
UV Psc	52874.5971	0.0008	I	V	MZ; RL400
EI Sge	52141.4987	0.0030	II	R	MZ; RL400
XY Sct	52437.4896	0.0020	I	C	MZ; RL400
XY Sct	52492.4580	0.0036	I	V	MZ; RL400
XY Sct	52492.4582	0.0034	I	R	MZ; RL400
XY Sct	52492.4584	0.0034	I	C	MZ; RL400
XY Sct	52878.4100	0.0027	II	C	MZ; RL400
XY Sct	52878.4107	0.0026	II	R	MZ; RL400
XY Sct	52878.4101	0.0028	II	V	MZ; RL400
DK Sct	52837.4255	0.0037	I	C	MZ; RL400; normal
FG Sct	52440.4349	0.0047	I	R	MZ; RL400
FG Sct	52524.3125	0.0022	I	R	MZ; RL400
FG Sct	52524.3127	0.0023	I	V	MZ; RL400
BU Ser	52133.4553	0.0081	I	C	MZ; RL400
LX Ser	52828.4165	0.0009	I	C	MZ; RL400
Y Sex	51965.4701	0.0036	I	C	MZ; RL400
AH Tau	52145.5354	0.0015	I	R	MZ; RL400
AP Tau	52279.4866	0.0047	I	C	MZ; RL400; normal
EN Tau	52279.5179	0.0014	I	R	MZ; RL400
IV Tau	51924.3177	0.0018	I	C	MZ; RL400
X Tri	52133.5043	0.0022	I	C	MZ; RL400
RS Tri	52213.5015	0.0031	I	C	MZ; RL400
RV Tri	52133.4651	0.0045	I	C	MZ; RL400
RW Tri	52274.3665	0.0012	I	R	MZ; RL400; normal

Times of minima:

Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
ST Tri	51569.2131	0.0058	II	C	MZ; RL400; normal
ST Tri	51569.4498	0.0067	I	C	MZ; RL400; normal
ST Tri	51580.2219	0.0036	II	C	MZ; RL400; normal
ST Tri	51580.2324	0.0034	II	V	MZ; RL400; normal
ST Tri	51752.4441	0.0087	I	C	MZ; RL400; normal
ST Tri	51771.6093	0.0042	I	C	MZ; RL400; normal
ST Tri	51772.5724	0.0034	I	V	MZ; RL400; normal
ST Tri	51777.5693	0.0040	II	C	MZ; RL400; normal
ST Tri	51876.5205	0.0030	I	C	MZ; RL400; normal
ST Tri	51924.4263	0.0022	I	C	MZ; RL400
ST Tri	52133.5372	0.0059	II	C	MZ; RL400
ST Tri	52138.5645	0.0036	I	R	MZ; RL400
ST Tri	52138.5616	0.0038	I	C	MZ; RL400
ST Tri	52198.4446	0.0023	I	C	MZ; RL400
ST Tri	52198.4426	0.0039	I	V	MZ; RL400
ST Tri	52198.4442	0.0032	I	R	MZ; RL400
ST Tri	52213.5318	0.0081	II	C	MZ; RL400
ST Tri	52229.3430	0.0035	II	C	MZ; RL400
ST Tri	52229.3439	0.0074	II	V	MZ; RL400
ST Tri	52229.3466	0.0033	II	R	MZ; RL400
ST Tri	52234.6115	0.0038	II	C	MZ; RL400; normal
ST Tri	52578.3319	0.0018	I	R	MZ; RL400
ST Tri	52578.3328	0.0025	I	V	MZ; RL400
ST Tri	52578.5712	0.0027	II	R	MZ; RL400
ST Tri	52578.5752	0.0046	II	V	MZ; RL400
ST Tri	52585.2761	0.0098	II	V	MZ; RL400; normal
ST Tri	52585.2814	0.0035	II	R	MZ; RL400
ST Tri	52900.4953	0.0044	II	C	MZ; RL400
ST Tri	52900.4921	0.0042	II	R	MZ; RL400
ST Tri	52900.4954	0.0041	II	I	MZ; RL400
ST Tri	52900.4914	0.0044	II	V	MZ; RL400
23360281 Tri	51924.3389	0.0020	I	C	MZ; RL400
23360281 Tri	52133.5310	0.0018	II	C	MZ; RL400
23360281 Tri	52138.5822	0.0025	I	C	MZ; RL400
23360281 Tri	52138.5817	0.0024	I	R	MZ; RL400
23360281 Tri	52147.5647	0.0033	I	R	MZ; RL400
23360281 Tri	52147.5662	0.0032	I	C	MZ; RL400
23360281 Tri	52198.4563	0.0038	I	V	MZ; RL400
23360281 Tri	52198.4577	0.0035	I	R	MZ; RL400
23360281 Tri	52198.4579	0.0027	I	C	MZ; RL400
23360281 Tri	52198.6443	0.0036	II	C	MZ; RL400
23360281 Tri	52213.4228	0.0049	I	C	MZ; RL400
23360281 Tri	52213.4275	0.0049	I	R	MZ; RL400
23360281 Tri	52213.6139	0.0022	II	C	MZ; RL400
23360281 Tri	52213.6142	0.0038	II	R	MZ; RL400
23360281 Tri	52521.5963	0.0020	I	R	MZ; RL400
23360281 Tri	52521.5997	0.0019	I	V	MZ; RL400
23360281 Tri	52524.5901	0.0024	I	R	MZ; RL400
23360281 Tri	52524.5907	0.0024	I	V	MZ; RL400
23360281 Tri	52229.3307	0.0039	II	R	MZ; RL400
23360281 Tri	52229.3308	0.0041	II	V	MZ; RL400
23360281 Tri	52229.3311	0.0042	II	C	MZ; RL400
23360281 Tri	52229.5181	0.0044	I	V	MZ; RL400
23360281 Tri	52229.5201	0.0038	I	C	MZ; RL400
23360281 Tri	52229.5206	0.0038	I	R	MZ; RL400
23360281 Tri	52234.5702	0.0034	II	R	MZ; RL400
23360281 Tri	52234.5703	0.0034	II	C	MZ; RL400
23360281 Tri	52234.5705	0.0028	II	V	MZ; RL400
23360281 Tri	52900.4937	0.0037	I	V	MZ; RL400

Times of minima:

Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
23360281 Tri	52900.4941	0.0039	I	C	MZ; RL400
23360281 Tri	52900.4945	0.0039	I	R	MZ; RL400
23360281 Tri	52900.4947	0.0037	I	I	MZ; RL400
IW UMa	53110.3582	0.0032	I	V	MZ; RL400
IW UMa	53110.3583	0.0033	I	I	MZ; RL400
IW UMa	53110.3577	0.0032	I	R	MZ; RL400
VV Vir	52684.5590	0.0043	II	R	MZ; RF80
VV Vir	53029.6433	0.0031	I	R	MZ; RL400
AZ Vir	52002.3862	0.0017	I	C	MZ; RL400
AZ Vir	52751.3675	0.0011	I	I	MZ; RF80
AZ Vir	52751.5422	0.0016	II	I	MZ; RF80
AZ Vir	52765.5310	0.0015	II	R	MZ; RF80
AZ Vir	53068.5141	0.0022	I	R	MZ; RF80
BF Vir	52002.4191	0.0016	I	C	MZ; RL400
DM Vir	52684.6051	0.0016	I	R	MZ; RF80
DY Vir	52672.5857	0.0077	I	R	MZ; RL400
HT Vir	52751.5760	0.0011	II	I	MZ; RF80
HT Vir	52751.3701	0.0014	I	I	MZ; RF80
HT Vir	52765.4368	0.0011	II	R	MZ; RF80
HT Vir	53068.5426	0.0017	I	R	MZ; RF80
VY Vul	53170.4084	0.0018	I	R	MZ; RL400
BP Vul	53186.4111	0.0031	I	R	MZ; RL400
DR Vul	52832.4968	0.0018	II	R	MZ; RF80
DR Vul	52859.5067	0.0025	II	I	MZ; RF80
DR Vul	52859.5082	0.0027	II	R	MZ; RF80
FF Vul	51752.4445	0.0030	I	C	MZ; RL400; normal
FM Vul	52437.4776	0.0042	I	C	MZ; RL400; normal
FR Vul	52815.4854	0.0017	I	R	MZ; RF80
FW Vul	53186.4439	0.0041	I	R	MZ; RL400
GI Vul	53170.4958	0.0038	I	R	MZ; RL400
GP Vul	53170.4630	0.0038	II	R	MZ; RL400
GP Vul	53186.4669	0.0048	I	R	MZ; RL400
NO Vul	53170.4263	0.0026	II	R	MZ; RL400

Remarks:

The timings of minima presented in this fifth list were obtained from 30255 CCD observations of author (MZ) or in several cases together with KK = Karel Koss, DM = David Motl, OP = Ondřej Pejcha, JŠ = Jan Šafář.
new var. = variability of the star was discovered by author; normal times of minima were obtained by superposition of two or more parts of light curve from different nights.
These observations are used especially to improve the light ephemeris of stars given in catalogue BRKA of observing programme of eclipsing binaries of BRNO-Variable Star Section. The catalogue contains more than 1500 eclipsing binaries and it is updated at least once per year. It is available on `http://var.astro.cz/brno`.

Acknowledgements:

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ERRATA FOR IBVS 5583

The following corrections were communicated to IBVS by Petr Zasche and the author, Miloslav Zejda. The times of minima for HT Vir were erroneously given in the article, and should be replaced by those given below.

Star name	Corrected time of min.
HT Vir	52751.5845
HT Vir	52751.3807
HT Vir	52765.4468
HT Vir	53068.5504

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DISCOVERY OF SPECTRAL VARIABILITY OF POST-AGB STAR SAO 40039

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We present the first results obtained in the course of spectroscopic monitoring of the poorly-studied post-AGB star SAO 40039. A high-luminosity star SAO 40039 ($B = 10\overset{m}{.}1$ (Fujii et al., 2002)) is located close to the galactic plane in the direction close to the anticenter of Galaxy ($l = 159\overset{\circ}{.}8$, $b = 4\overset{\circ}{.}8$). Based on BVRIJHK photometry, Fujii et al. (2002) classified the star as A4 Ia. It is identified with the IR-source IRAS 05040 + 4820. Its double-peaked spectral energy distribution and its position in the IRAS color-color diagram confirm the post-AGB status. There is no H_2O, SiO or CO maser associated with the source IRAS 05040 + 4820 (Wouterloot & Brand, 1989; Wouterloot et al. 1993). According to the Lewis (1989) chronological sequence, this means that SAO 40039 is close to the PN stage. This conclusion is also confirmed by the sufficiently high temperature of the central star and a low temperature of the dusty envelope (Fujii et al., 2002).

Our spectral observations of SAO 40039 were made at the 6-m telescope of the Special Astrophysical Observatory with the echelle-spectrograph NES (Nasmyth focus, 2K×2K CCD-chip, $R \geq 60000$ (Panchuk et al. 2002, `http://www.sao.ru/hq/ssl/NES.html`). The journal of observations is presented in Table 1. The data reduction process (cosmic ray trace removal, background subtraction, and spectral order extraction) were done under the standard ECHELLE context of the MIDAS package. The cosmic ray traces were removed by median averaging of two subsequent spectra. A hollow cathode Th-Ar lamp was used for wavelength calibration. The radial velocities were measured by matching the original and mirrored profiles of individual lines. A typical error in the V_r measurements for a single line is about $1\,\mathrm{km\,s^{-1}}$.

Table 1: Observing log for SAO 40039

Date	Exposure time, s	Spectral range Å	Resolving power, R	$\overline{S/N}$
02/12/2002	2×3600	4520–6000	60000	75
09/09/2003	2×3600	4520–6000	60000	100
10/01/2004	2×3600	5280–6760	75000	85
08/03/2004	2×3600	5280–6760	75000	115

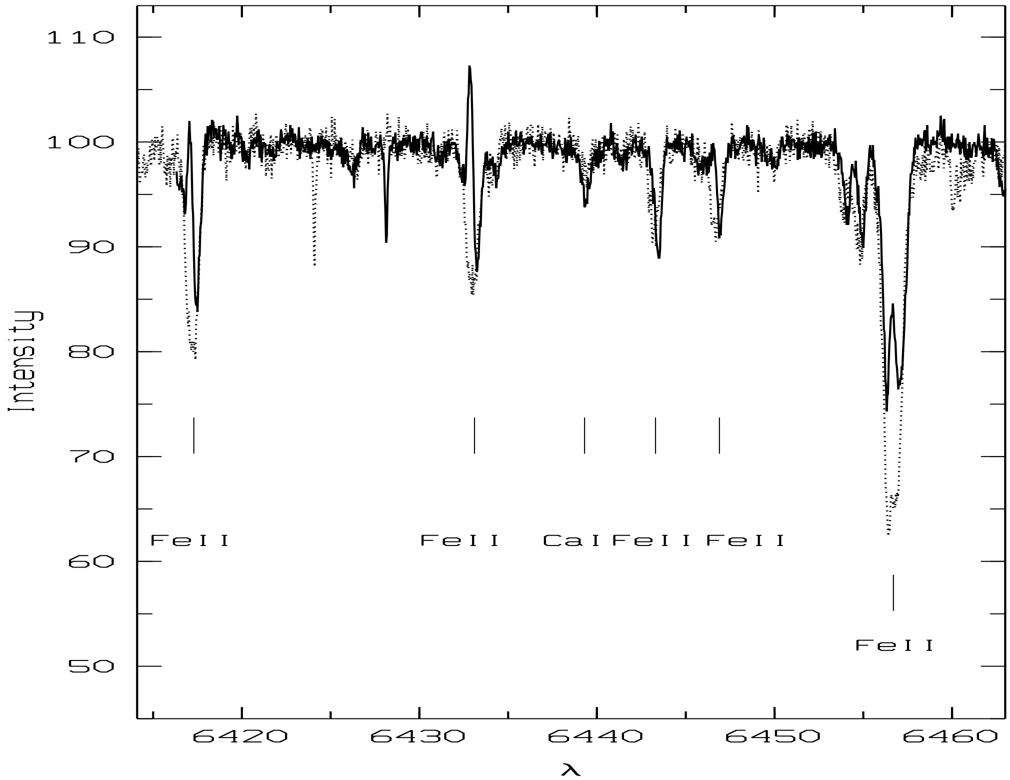

Figure 1. A fragment of two spectra of SAO 40039: 08/03/2004 – solid line, 10/01/2004 – dotted.

The main peculiarity of the SAO 40039 spectrum is the presence of complex emission-absorption profiles of Hα and some metallic lines. In addition, comparing spectra obtained at different epochs, we reveal strong variability both in numerous metallic lines (Fig. 1, Fig. 2) and in Hα (Fig. 3).

Table 2: Heliocentric V_r (km s^{-1}) in the spectra of SAO 40039

Ion (Mult.)	02/12/2002	09/09/2003	10/01/2004	08/03/2004
Cores of absorption lines:				
Fe II, Cr II, etc. (r $\to$ 1)	-14.8	-6.8	-15.3	-8.2
Hα	—	—	-27	-28
Hβ	-14.8	-10.6	—	—
Wings of weak absorptions				
at r = 0.90 ÷ 0.95	-14	-9.5	-15.5	-13.0
Maximum extension of blue wings:				
Fe II(42)	-70	-61	-65 :	-70
Hα	—	—	-65 :	-57 :
Emission lines:				
Fe II(40, 46)	—	—	—	-18
Hα	—	—	-15	-13 :
I.S. NaI (1)	-25, -3	-26, -2	-27, -2.5	-28, -2
DIB	—	—	-3 :	-2.5 :

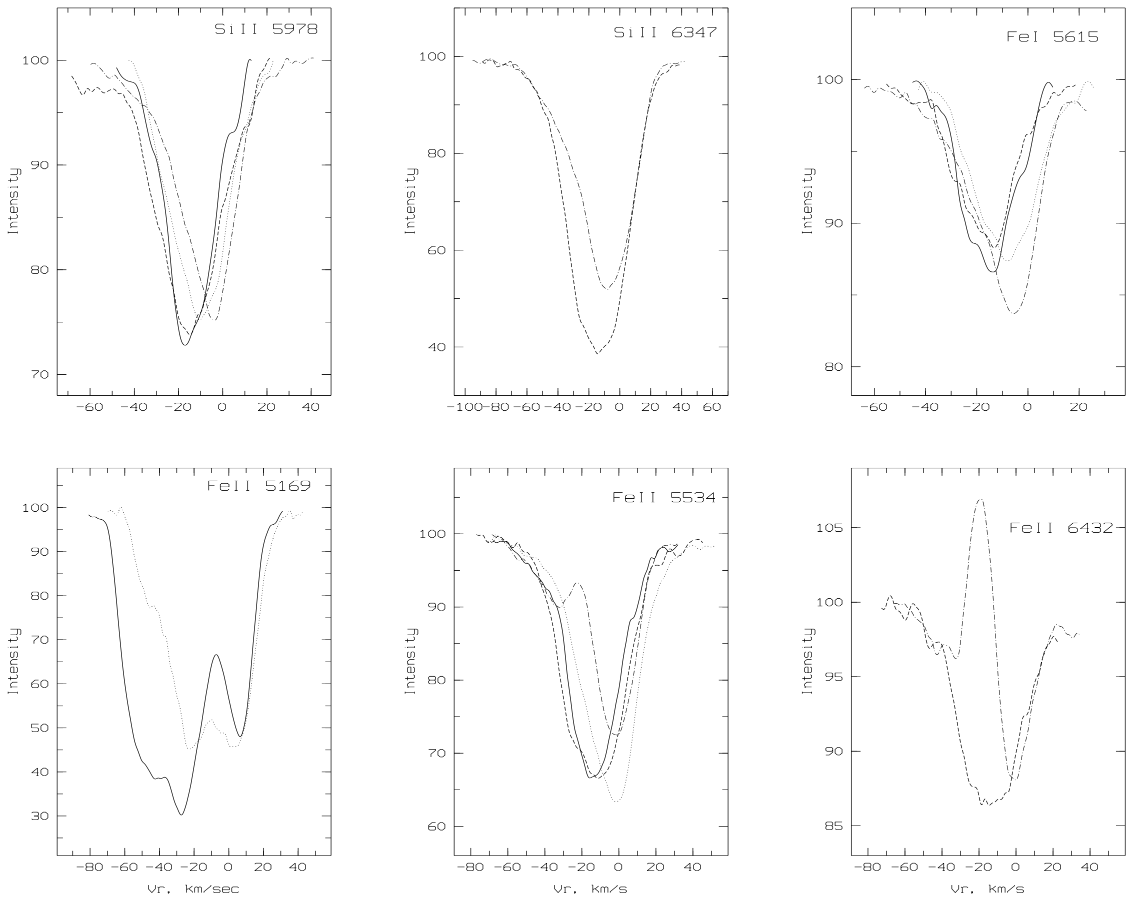

Figure 2. Temporal variability of selected lines in the SAO 40039 spectra. 02/12/2002 – solid line, 09/09/2003 – dotted, 10/01/2004 – dashed short, 08/03/2004 – dash-dot.

The heliocentric V_r values derived from absorption and emission lines and/or their components at different epochs are shown in Table 2. Our present time coverage does not allow us to comment on possible reasons for the variability found. Significantly variable V_r were revealed in most of the absorption lines (except for V_r values determined on the wings of the weak absorptions at depth $\mathrm{r} = 0.90 \div 0.95$). As seen in Fig. 2, variability in the central part of the line profiles ($V_r \approx -20\,\mathrm{km\,s^{-1}}$) could be caused by variable emission. These variations are especially remarkable in the Fe II (40) lines. In the blue wings of the strongest Fe II (42) lines, however, variability is caused by variable absorption along the line of sight. As a first approximation, the value $\mathrm{V_r} \approx -13\,\mathrm{km\,s^{-1}}$ that follows from the wings of weak ($0.75 < \mathrm{r} < 0.92$) absorption lines could be adopted as a systemic velocity $\mathrm{V_{sys}}$ ($\mathrm{V_{lsr}} \approx -20\,\mathrm{km\,s^{-1}}$).

Using high resolution spectra, we classified SAO 40039 as a A4 Ib star ($\mathrm{Mv} \approx -5^{\mathrm{m}}$), which is consistent with the result published by Fujii et al. (2002). The determination of the stellar luminosity leads us to the distance value of $\mathrm{d} \approx 4\,\mathrm{kpc}$. This distance fits very well with the systemic velocity of $\mathrm{V_{lsr}} \approx -20\,\mathrm{km\,s^{-1}}$. Besides, as follows from Table 2, a velocity component of $\mathrm{V_r} \approx -25 \div -28\,\mathrm{km\,s^{-1}}$ is present in the interstellar NaD lines (Fig. 3). According to Münch (1957), distant stars HD 232299, BD + 43°1168 and HD 232947 which exist at galactic latitudes close to SAO 40039, have similar double-peaked NaD line profiles with components at $\mathrm{V_r} \approx -(20 \div 38)$ and $-(1 \div 3)\,\mathrm{km\,s^{-1}}$ having intensities approaching those in the SAO 40039 spectra.

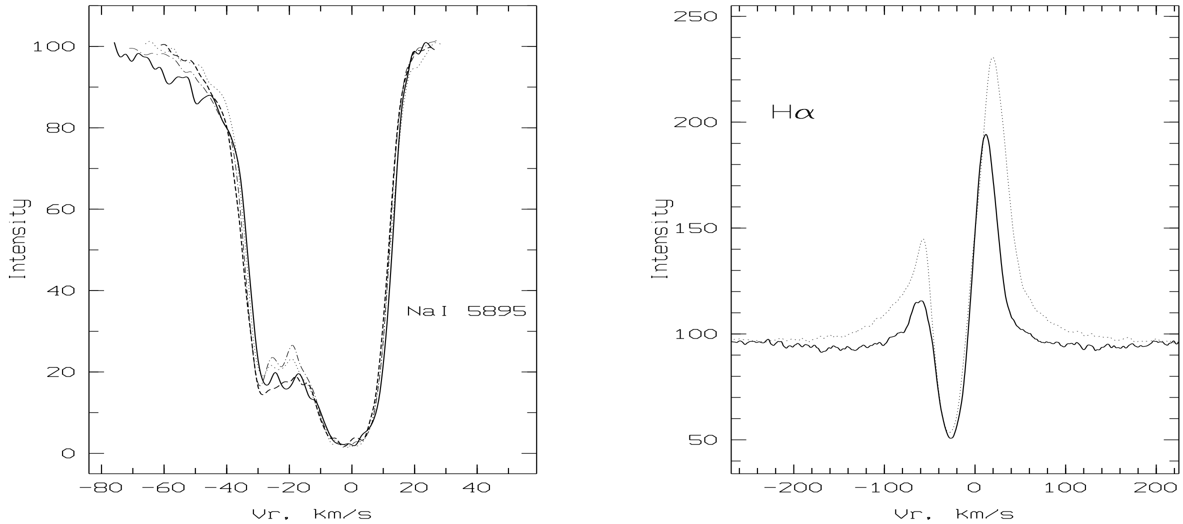

Figure 3. The same as in Fig. 2 but for Na I 5895 Å and Hα.

Since the spectrum of SAO 40039 contains many absorption lines without visible emission components, it is possible to estimate metalicity and abundances of selected chemical elements in its atmosphere. However, we have to keep in mind that both the model parameters and chemical composition, determined for such a luminous star with the unstable and extended gaseous-dusty envelope in the framework of a static plane-parallel atmospheric model under the LTE approach, can be considered as a first approximation only. The comparison of spectra of SAO 40039 with a grid of theoretical spectra that were calculated by us permits us to obtain the following model parameters for the star: $T_{eff} \approx 8000$ K, $\log g \approx 1.0$, $\xi_t \approx 6\,\mathrm{km\,s^{-1}}$, $[Fe/H]_\odot = -0.3$ and C, O overabundances. In summary, stellar parameters and chemical abundances pattern of SAO 40039 resemble to a PPN candidate HD 187885 = IRAS19500−1709 (Van Winckel et al., 1996).

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CATACLYSMIC VARIABLES IN OPEN CLUSTERS: EU Cnc

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Magnetic CVs (MCVs) or polars are semi-detached binary systems, in which a lower main sequence Roche-lobe filling star loses mass to its highly magnetic ($B \geq 10^7$G) white dwarf companion. H-rich material is channeled to the magnetic poles of the white dwarf, emitting most of the observed light of the system. When found in star clusters, they provide us with the rare opportunity to study their formation environment and extract information such as their age, distance and metalicity. Globular clusters favor the formation of CVs via tidal interactions in their dense environment, although an intriguing aspect is that a large fraction of the globular cluster CVs appear to be magnetic, raising the possibility that they reflect a new class of objects (Grindlay et al. 1995).

Only three CVs are known to populate open clusters in spite of relevant searches (see for example Kafka et al. 2004). One of them, EU Cnc, is a magnetic CV in the central region of the rich and old (4.0 ± 0.5Gy; Percival & Salaris 2003) open cluster M67 (Gilliland et al. 1991). Its discovery was followed by X-ray studies (e.g. Belloni et al. 1993, 1998; Van den Berg et al. 2004) confirming the magnetic nature of the system. Low-resolution spectra of EU Cnc (Pasquini et al. 1994) revealed a quite variable spectrum with the He II 4686 line in emission and cyclotron humps. Being the only MCV in an open cluster, EU Cnc can be the representative of a unique open cluster CV population, providing valuable information on the properties of a system that was likely formed through a common envelope process, representing more accurately field MCVs. We recently monitored the system in one filter confirming its orbital period and light curve characteristics as presented in the discovery paper of Gilliland et al. (1991). In the followings, we describe our data and data reduction techniques, and present a discussion on our findings, placing EU Cnc in the larger framework of globular cluster CVs and field polars.

The observations were made on 26-Feb-2004 with the Mini-Mosaic CCD camera on the 3.5-m WIYN telescope at Kitt Peak. A total of 32 300-s V-band exposures were obtained under photometric conditions. Data processing (bias subtraction and flat fielding) was conducted using the standard IRAF routines. An additional step of masking was performed using the IRAF routines IMUTIL/IMEXPR, to eliminate ghost images due to cross-talk between the amplifiers of the CCD; bad pixel masking was also applied. For data reduction, we used IRAF/DAOPhot for PSF photometry. The instrumental magnitudes from DAOPhot were then supplied to AstroVar, a custom interactive program based on the method of incomplete ensemble photometry (Honeycutt 1992), optimized for the detection and study of variables. Secondary stars from Gilliland et al. (1991)

were used to fix the zero point of the incomplete ensemble photometry. The 2.09h period from Gilliland et al. (1991) was verified by both periodogram analysis (Horne & Baliunas 1986) of the new data and by folding the new data on this period. Finally, we searched for variability of the X-ray sources in the field of M67 (Belloni et al. 1998). Although the systems are reported to be variable, no variability was detected, likely due to the short duration of our observations.

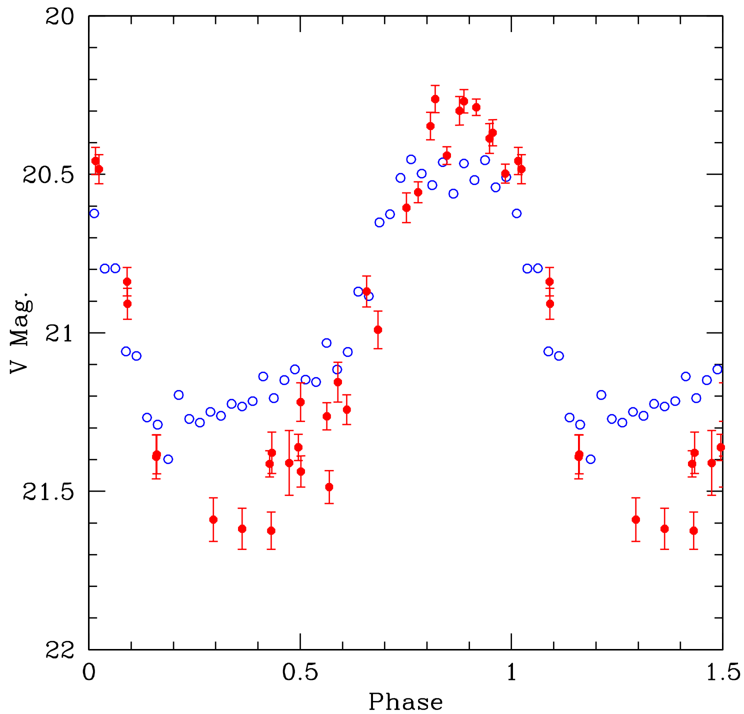

Figure 1. Folded light curves of EU Cnc. Filled circles with error bars are the 2004 WIYN data, while the open circles are the 1988 data of Gilliland et al. (1991).

Fig. 1 and Table 1 compare the 1988 and 2004 light curves. Noticeable similarities of the 1988 light curve of the system with that of VV Pup first suggested its the magnetic nature (Gilliland et al. 1991). The two light curves in Fig.1 have similar shapes, with a 30% larger amplitude in the 2004 light curve. Such changes are common in polars in the high optical state, and are likely due to changes in the mass accretion rate and/or accretion geometry. On the other hand, Gilliland et al. (1991) used a $CuSO_4$ filter which had an effective bandpass that covers both B and V. This could partially explain the light curve differences between the two epochs, since our 2004 data were obtained using a V filter. For an M67 distance modulus of 9.60±0.09 (Percival & Salaris 2003), the M_V range of EU Cnc is 12.0 to 10.6, which can be compared to field and globular cluster MCVs. We searched the literature (e.g Warner 1995, Berriman 1987, Cropper 1990, Harrison et al. 2004) for information on the absolute magnitudes (M_V) of polars. For field CVs, distance uncertainties result in large (1-2 mag) differences in the calculated M_V values. Parallactic distances are available for only two field polars (Thorstensen 2003); most of the distances of individual field MCVs we took from the literature used indirect methods. Fig. 2 shows the distribution of M_V for both the high and low states of MCVs, with the mean M_V of EU Cnc marked.

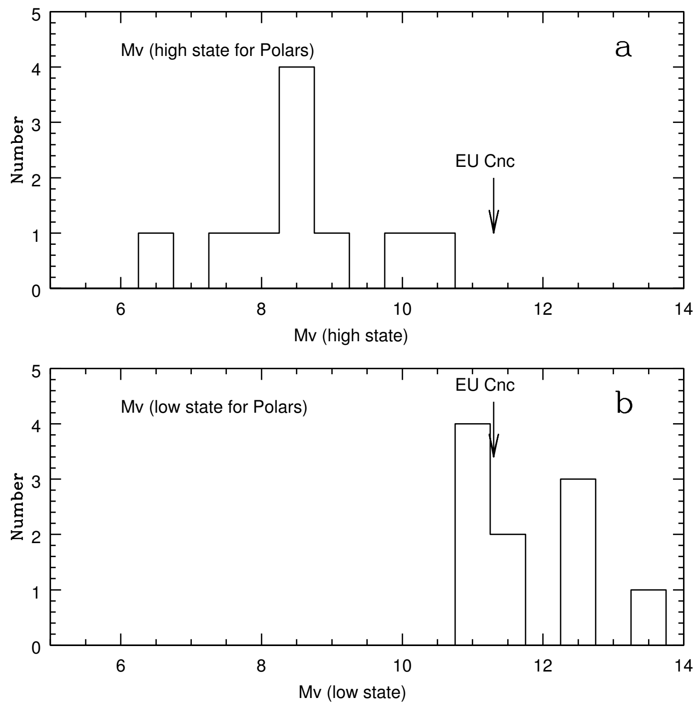

Figure 2. Histogram of M_V in the high (top) and low (bottom) photometric state for field polars. The position of EU Cnc is noted with arrows.

Note that the location of EU Cnc in Fig. 2 suggests that it is in a low optical state. However its large, 1-mag orbital modulation is characteristic of polars in the high state (low-state polars usually have variability of only a few tenths of a magnitude).

Fig. 3 shows a histogram of the absolute magnitude of globular cluster CVs taken from the literature, the majority of which appear to be magnetic, based on their X-ray properties. On the other hand, globular clusters systems are not observed well enough to assess high/low state magnitudes; therefore, Fig. 3 presents the mean "snapshot" magnitude of the systems. It is interesting that EU Cnc is about a magnitude fainter than globular cluster CVs, again suggesting a low state behavior.

Table 1: Parameters of EU Cnc

Epoch	m_V	M_V	Amplitude
1988	21.4-20.5	11.8-10.9	0.9
2004	21.6-20.3	12.0-10.7	1.3

More data are needed for further exploration of the properties of this understudied CV, including the long-term variations in its optical light curve and its spectroscopic properties. Considering that open clusters more accurately represent the galactic disk population, EU Cnc might shed light on the environment and timescales for CV formation and evolution. Alternatively, it may turn out to be a part of a different CV population, affected by the metal rich environment of open clusters.

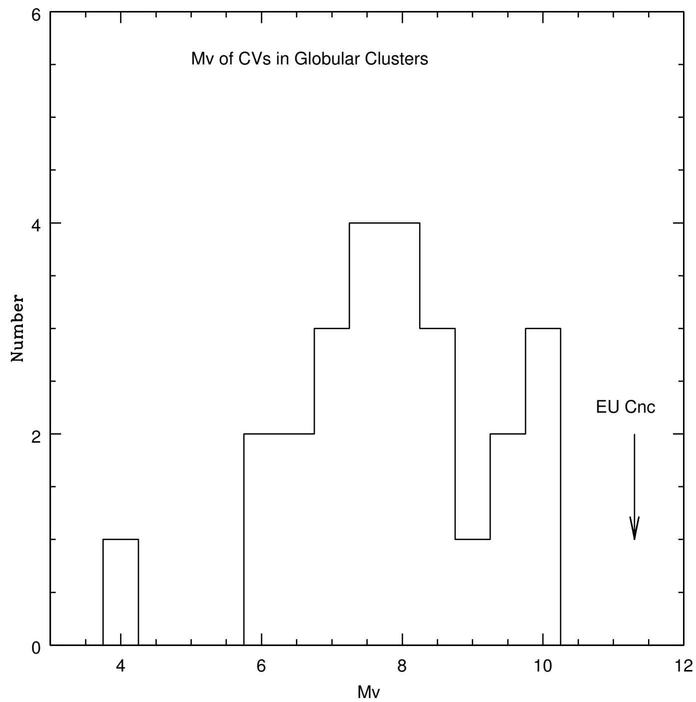

Figure 3. Histogram of M_V of the known globular cluster CVs. The position of EU Cnc in this graph is noted with an arrow

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NEW ELEMENTS FOR 80 ECLIPSING BINARIES V.

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The ASAS-3 (Pojmanski, 2002), NSVS (Wozniak et al., 2004) and Hipparcos (Perryman et al., 1997) databases have been used to find new elements for a fifth set of 80 eclipsing binaries. NSVS, ASAS-3 and Hipparcos data have been combined to improve the period determinations. Unfiltered NSVS ROTSE1 magnitudes were shifted to match the V magnitude of the stars. In all cases the amplitude of the eclipses were the same for all datasets so the combination was successful. When neither ASAS nor Hipparcos observations exist, the original ROTSE1 magnitudes have been given. Saturated data in ASAS-3 and flagged observations in the Hipparcos Epoch Photometry and the NSVS dataset were also discarded. Hipparcos observations have been transformed to V using a table by the author published electronically in IBVS No. 5482 (Otero, 2003). The candidate stars were selected from the Hipparcos Variability Annex and the NSV catalogue (Kukarkin and Kholopov, 1982) and its supplement (NSVS) (Kazarovets et al., 1998). Stars classified as eclipsing binaries and those showing mean Hp magnitudes close to the maximum Hp values in the Hipparcos Variability Annex were identified and their ASAS-3 and/or NSVS data subsequently obtained. Stars classified as possible eclipsing systems (of all types) and those with a spectral type between O and G that had no given classification within the NSV catalogues were also checked. The method of bisected chords was used to determine times of minima. The accuracy depends on the quantity and quality of the observations. Elements were found with AVE (Barberá, 1999) and a Microsoft Excel period search utility. Table 1 shows the list of variables. The first column gives the variable star designation according to the GCVS. The following columns give another identifier; the brightness range of the variable (V= ASAS-3 or Hipparcos V magnitudes; *= ROTSE1 magnitudes), with the magnitude of secondary eclipse between brackets; the epoch of minimum light derived from the complete dataset; the period; the variability class and the spectral type with a note to the spectral type source.

Table 1. New elements for 80 eclipsing binary stars.

Star Name		Magnitude range	Epoch	Period	Type	Spectral type
Variable	Other ID		(HJD2440000+)	(days)		
BX Psc *	HIP 001435	7.53 – 7.60 (7.55)	8984.837	3.86051	EB:	A5 (24)
CX CVn *	HIP 068384	9.34 – 9.60 (9.53:)	8455.639	6.563204	EA	
DD Oct *	HIP 098832	9.68 – 10.10 (9.86)	7999.344	2.83071	EA	F2V (1)
DT Cam *	HIP 024390	8.13 – 8.80:(¡8.6)	8501.355	14.1325	EA	A2 (24)
LX Mus *	HIP 066683	8.76 – 9.09 (8.99)	8770.665	11.75056	EA	F5V (1)
NSV 00049	GSC 3258 0448	12.00– 12.44(12.41)*	11324.849	0.332004	EW	
NSV 00381	GSC 4021 1459	12.57– 13.0 (12.75)*	11415.814	0.67708	EB	
NSV 00583*	GSC 2298 0114	14.1 – ¡15.2 (14.5)*	11338.067	2.0582	EA	
NSV 00587	GSC 4314 1709	11.80– 12.55:(11.9)*	11343.082	4.922	EA	
NSV 01009*	GSC 4048 0934	10.26– 10.56(10.52)*	11601.625	4.1278	EA	O7(V) (18)
NSV 01085	GSC 2860 1725	12.2 – 13.4 (12.4)*	11342.857	7.2778	EA	
NSV 01180	GSC 2354 1811	11.89– 12.17(12.03)*	11479.080	77.53	EA	
NSV 01447*	GSC 2366 3002	11.22– 11.87(11.87)*	11397.995	0.373042	EW	
NSV 01916	GSC 8959 0532	12.87– 13.21(13.19)*	11509.098	0.52878	EW	
NSV 02432	GSC 2910 0265	11.84– 12.19(12.16)*	11598.723	4.2650	EA	
NSV 02591	GSC 2413 0376	12.55– 13.2:(13.10)*	11548.612	0.71003	EW	
NSV 02621*	GSC 2923 1243	13.0 – 13.5 (13.25)*	11531.634	1.1833	EB:	
NSV 02951	GSC 3376 0052	13.97– 15.0 (14.35)*	11517.640	2.0338	EA	
NSV 03008	GSC 2422 0224	13.78– 15.2 (13.8:)*	11519.672	4.3976	EA	
NSV 03186	HD 262834	10.22– 10.57(10.55)	13070.563	1.446303	EA	F8 (33)
NSV 03844	GSC 5412 0417	12.9 –¡14.4(not obs)	12623.834	3.10835	EA	
NSV 04029	GSC 4380 1811	13.75–¡14.3 (14.27)*	11520.823	1.66439	EA	
NSV 04050	GSC 6009 3746	11.66– 12.14(11.72)	11899.769	1.80488	EA	
NSV 04069	GSC 1941 0409	11.90– 12.33(12.27)	11598.746	0.717775	EB	
NSV 04083	GSC 5436 2588	12.70– 14.1(12.75:)	12388.485	2.51875	EA	
NSV 04207*	GSC 1399 0798	12.5 – 12.9 (12.9)	11560.714	0.363675:	EW:	
NSV 04546	GSC 8941 0668	12.3 – 13.15(12.35:)	12954.874	11.8884	EA	
NSV 04572*	GSC 8589 0265	12.45– 13.45(12.79)	12929.846	2.78678	EA	
NSV 05233	GSC 9233 0346	13.20– 13.55:(13.45)	12055.505	0.969605	EA	
NSV 05644	GSC 4400 0006	11.86– 12.10 (11.9)*	11620.769	0.84034	EA	F2 (14)
NSV 05756*	GSC 9240 0124	13.00– 13.75:(13.7:)	13087.755	2.19461	EA	
NSV 06722	GSC 9269 2564	12.35– 14.0:(12.4:)	12867.455	5.05085	EA	
NSV 06842	AC 4282175	12.62– 14.4:(12.72)	12635.842	1.83777	EA	
NSV 07446*	GSC 4638 0951	12.10– 12.52(12.52)*	11420.948	0.48885	EW	
NSV 08493	GSC 0408 0226	11.80– 12.27(12.21)	11325.797	0.386182	EW	
NSV 10858	GSC 9080 1805	13.15– ¡15.0(13.25:)	12206.573	1.85188	EA	
NSV 11075*	HD 171379	9.64 – 9.89:(9.89:)	12124.556	23.1868	EA	Fm del Del (2)
NSV 11335*	AC 3914867	12.40– 13.36 (12.6)	12082.640	2.65996	EA	
NSV 11359	GSC 8377 0837	11.78– 12.28(11.88)	11962.854	1.3675	EA	
NSV 11822	GSC 3550 1770	12.64– 13.2 (12.73)*	11483.590	0.90333	EA	
NSV 12263*	GSC 1061 1409	11.76– 12.45:(12.40)	11486.657	0.962992	EA	
NSV 12945*	GSC 2683 3724	11.70– 12.15 (12.1)	11415.730	18.88	EB/GS:	
NSV 13506	GSC 3172 0169	12.32– 13.1 (12.7:)*	11282.436	0.66927	EA	
NSV 13635	HD 235475	9.96 – 10.42(10.40)*	11288.827	0.85785	EW	F8 (33)
NSV 13637*	GSC 3173 1826	9.65 – 10.14 (9.8)*	11518.644	1.27268	EA	A2 (24)
NSV 13638	GSC 1662 1759	12.44– 12.85(12.70)	13185.827	0.427417	EB	
NSV 13695	GSC 4252 0433	11.95– 12.33(12.30)*	11448.669	0.298755	EW:	
NSV 14062*	GSC 3614 0351	12.44–13.05(13.05:)*	11423.743	1.9881	EA	
NSV 14110*	GSC 3986 0860	10.53– 10.85:(10.8:)*	11542.684	4.6722	EA	B0III (36)
NSV 14241	GSC 9337 1951	12.50– 13.21(13.08)	12134.686	0.337259	EW	
NSV 14327*	GSC 3621 0146	12.52– 13.4 (12.75)*	11505.640	1.34795	EA	
NSV 14332	GSC 3625 1048	13.06– 13.6:(13.5:)*	11305.062	1.7679	EA	
NSV 14500	GSC 3636 0729	12.25– 12.81(12.78)*	11483.638	4.279	EA	
NSV 15024	GSC 4018 2473	12.59– 13.20(12.80)	11421.720	11.038	EA	
NSV 16225	HIP 032218	8.91 – 9.15 (9.05)	12997.720	4.14357	EA/RS:	G3/5V (5)
NSV 16352*	HD 290556	9.52 – 9.66 (9.64:)	11962.558	3.21472	EA	A2 (9)

Table 1. New elements for 80 eclipsing binary stars.

Star Name		Magnitude range	Epoch	Period	Type	Spectral type
Variable	Other ID		(HJD2440000+)	(days)		
NSV 17227*	HIP 033225	8.11 – 8.18 (8.14)	8574.663	0.697461	EB/KW:	K0 (24)
NSV 17353*	GSC 9178 1586	13.14– 13.9:(13.85:)	12752.573	1.57097	EA	
NSV 17646*	HIP 038466	8.91 – 8.98 (8.97)	12950.772	3.38771	EA	B5V (2)
NSV 17878	GSC 2977 1179	12.65–13.20(12.83)*	11611.870	0.64453	EB	
NSV 18149*	HIP 045171	7.90 – 7.98 (7.98)	8594.965	1.115657	EA/KE	A1/2III/IV (5)
NSV 18470*	HD 092406	9.08 – 9.37 (9.23)	12786.540	32.186	EA	Bp shell (1)
NSV 18601	HIP 054156	8.94 – 9.03 (8.98)	8220.840	1.081354	EB	F2V (5)
NSV 19345*	HIP 059869	9.55 – 10.1: (9.9:)	7945.451	11.30489	EA	G3V (2)
NSV 20276*	HIP 074355	8.02 – 8.14(8.13:)	8953.470	5.47798	EA	A2V (27)
NSV 20546*	HD 145614	9.54 – 9.72 (9.71)	12722.863	3.7297	EA	B9III (2)
NSV 20599	HIP 080022	8.19 – 8.30 (8.24)	13170.830	3.19288	EB	F6/7V (2)
NSV 24021*	HIP 087511	9.51 – 9.77 (9.75)	8744.790	4.39435	EA	F2/3V (5)
NSV 24229	GSC 6842 1237	9.60 – 9.93 (9.92)	12840.577	0.617262	EW:	B2Vne (17)
NSV 25285*		13.6 –14.3: (14.2:)*	11495.658	0.33999	EW	
NSV 25486*	GSC 2713 2372	10.89–11.9:(11.35:)*	11490.400	112.4:	EB/GS	
NSV 25517	HIP 104743	7.94 – 8.11 (7.97)	7977.020	11.42365	EA	F0V (5)
NSV 25632	GSC 3978 0622	10.00–10.29(10.25)*	11428.659	1.29827	EA	B1:V (8)
NSV 25859	GSC 3211 1072	12.49– 13.0:(13.0:)*	11383.798	3.1875	EA	
OW Hya *	HIP 047427	6.31 –6.66(not obs)	8791.310	14.39303	EA	A0Vn (24)
V0340 Hya*	HIP 061836	8.23 – 8.50 (8.36)	7948.452	3.64741	EA	A0V (3)
V0343 Sge*	HIP 097670	7.27 – 7.37 (7.30)	8168.050	6.01426	EA	B8n (48)
V0726 Sco	HD 155534	10.34– 10.48(10.46)	12481.543	1.20179	EA/KE	A0V (3)
V1129 Tau*	HIP 017873	7.62 – 7.84 (7.84)	8650.300	4.86058	EA/RS:	G0V (50)
V2148 Cyg*	HIP 104483	6.59 – 6.74 (6.7:)	8717.250	10.237	EA	B4IVp (47)

Notes on individual stars:

BX Psc = Might be EA. Wrong period in the HIP catalogue (5.1825 d.).
CX CVn = Period might be half the value given. Wrong period in the HIP catalogue is 1.64096 d. Visual binary. A=9.5; B=13.2 Hp. Sep. 1″.29 (Perryman et al., 1997).
DD Oct = Wide visual binary. A=9.8; B=13.0 V. Sep. 21″.4 (Dommanget and Nys, 2002).
DT Cam = Lack of observations at minima.
LX Mus = Eccentric system.
NSV 00583 = O'Connell effect. Max. II ROTSE1= 14.2.
NSV 01009 = Eccentric system. Visual binary. Sep. 1″.5 (Worley and Douglass, 1997).
NSV 01447 = Primary eclipse might be the secondary.
NSV 02621 = Might be EA.
NSV 04207 = Scatter.
NSV 04572 = Eccentric system.
NSV 05756 = Faint for ASAS. Period might be half the value given. Primary eclipse might be the secondary.
NSV 07446 = Primary eclipse might be the secondary.
NSV 11075 = Slightly eccentric. Primary eclipse might be the secondary.
NSV 11335 = USNO-A2.0 0450-35737102.
NSV 12263 = Classified as L: in the NSV catalogue (Kukarkin and Kholopov, 1982).
NSV 12945 = Wils and Greaves (2004) give it as a DCEP with a period of 9.5 d.
NSV 13637 = Wide visual binary. B= GSC 3173 1682, 11.5 V. Sep. 21″.0 (Fabricius et al., 2002).
NSV 14062 = Primary eclipse might be the secondary.

NSV 14110 = Eccentric system.
NSV 14327 = Spectrum M3 in Kholopov et al. (2004) is wrong. There is no red star in the area. 2MASS colors are for an F5 star.
NSV 16352 = Period might be half the value given.
NSV 17227 = Slight O'Connell effect.
NSV 17353 = Period might be half the value given.
NSV 17646 = Koen and Eyer (2002) give period = 1.69397 d.
NSV 18149 = Highly distorted EA. Period 0.557808 d. in the HIP catalogue with no variability type given.
NSV 18470 = Peculiar lightcurve. Emission line star. Spectrum also given as A1Iab (Stephenson and Sanduleak, 1971), B1.5V (Reed, 1998) and (B5V)p shell (Buscombe, 1998). Batten et al. (1989) give a spectroscopic period of 27.595 d.
NSV 19345 = Slightly eccentric. No data at minima.
NSV 20276 = Period might be half the value given. Visual binary. A=8.4; B=9.6 Hp. Sep. $0\farcs12$ (Perryman et al., 1997).
NSV 20546 = Slightly eccentric.
NSV 24021 = Slightly eccentric. Spectrum G5 in Ochsenbein (1980).
NSV 25285 = USNO-A2.0 1275-14063446.
NSV 25486 = Few cycles recorded for a reliable period determination. Classified as INS: in the NSV Supplement (Kazarovets et al., 1998).
NSV 25859 = Period might be half the value given.
OW Hya = Visual binary. A=6.4; B=8.8 Hp. Sep. $0\farcs36$ (Perryman et al., 1997) Period might be twice the value given.
V0340 Hya = Eccentric system. Wrong period in the HIP catalogue (3.8175 d.).
V0343 Sge = Eccentric system.
V1129 Tau = Mean magnitude changes. 0.1 magnitude difference between ASAS-3 and Hipparcos data. Amplitude of the eclipses is 0.1 mag. Period might be half the value given. Koen and Eyer give period = 1.9852 d. Possible T Tauri star according to Li and Hu (1998).
V2148 Cyg = Be star. Period might be wrong. Wrong period in the HIP catalogue (8.018 d.).

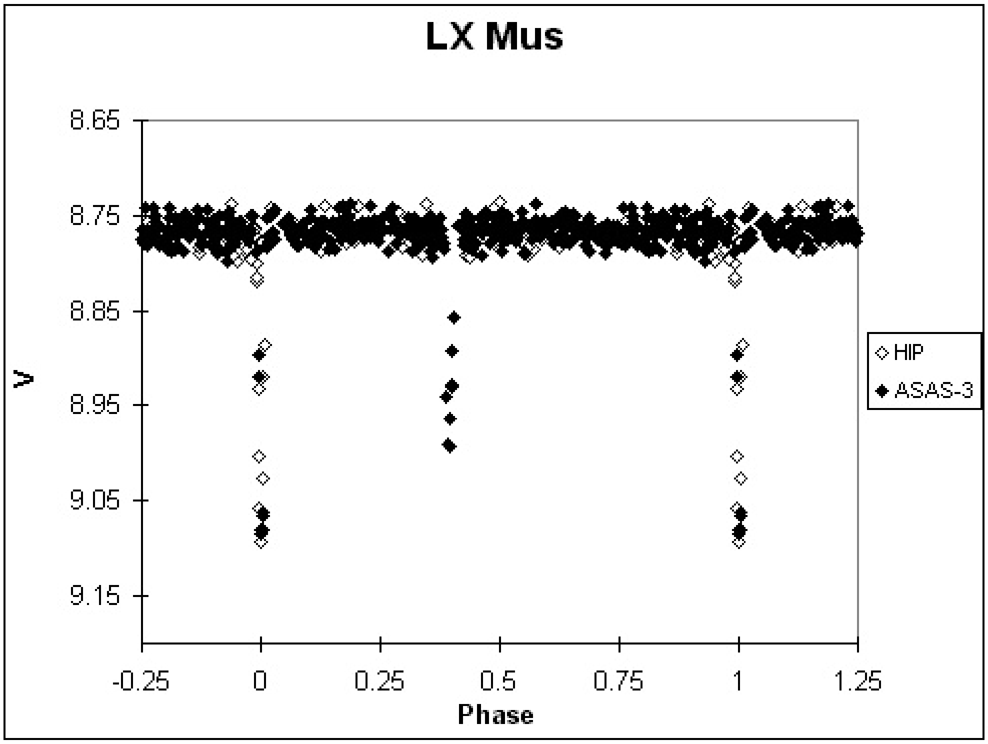

Figure 1. Light curve of LX Mus showing ASAS-3 and Hipparcos observations.

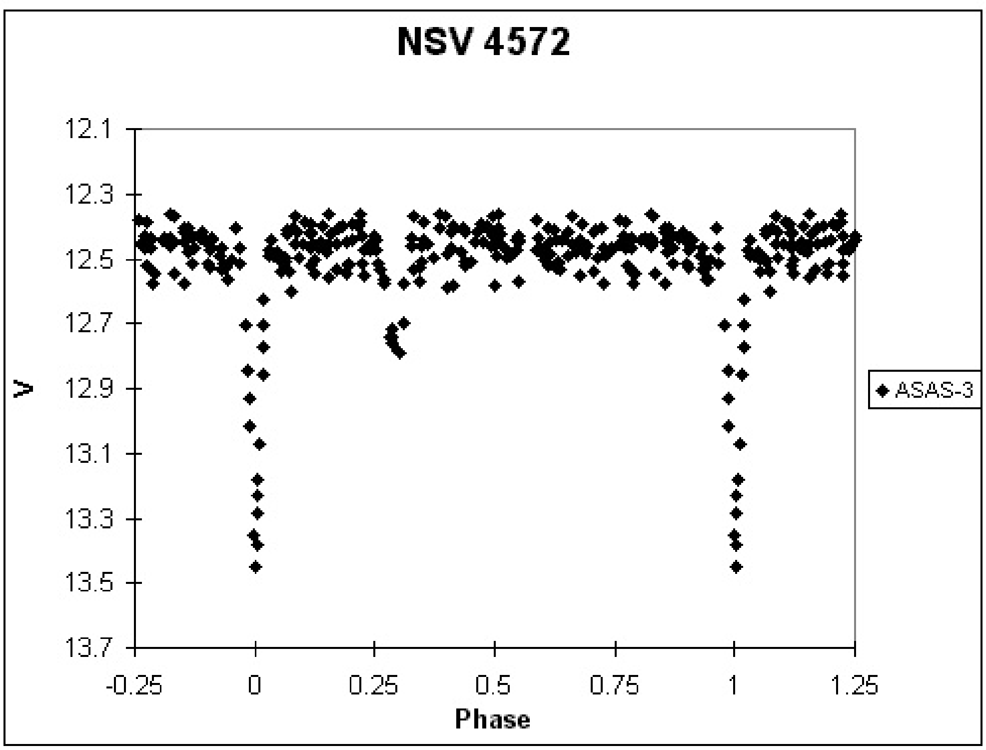

Figure 2. Light curve of NSV 4572 showing ASAS-3 observations.

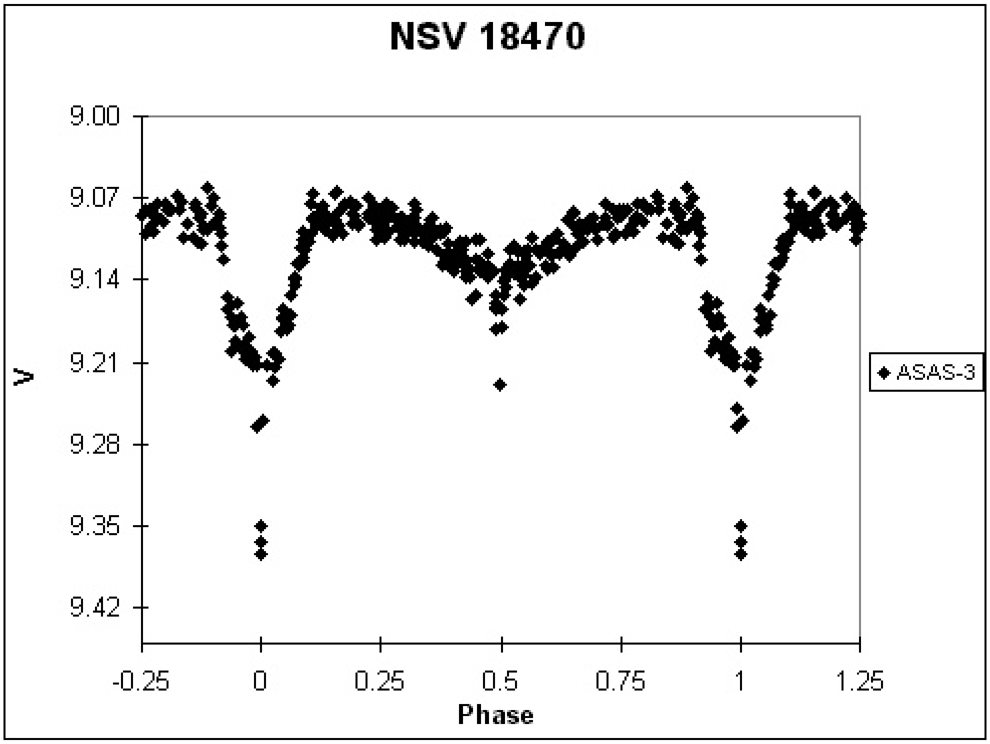

Figure 3. Light curve of NSV 18470 showing ASAS-3 observations.

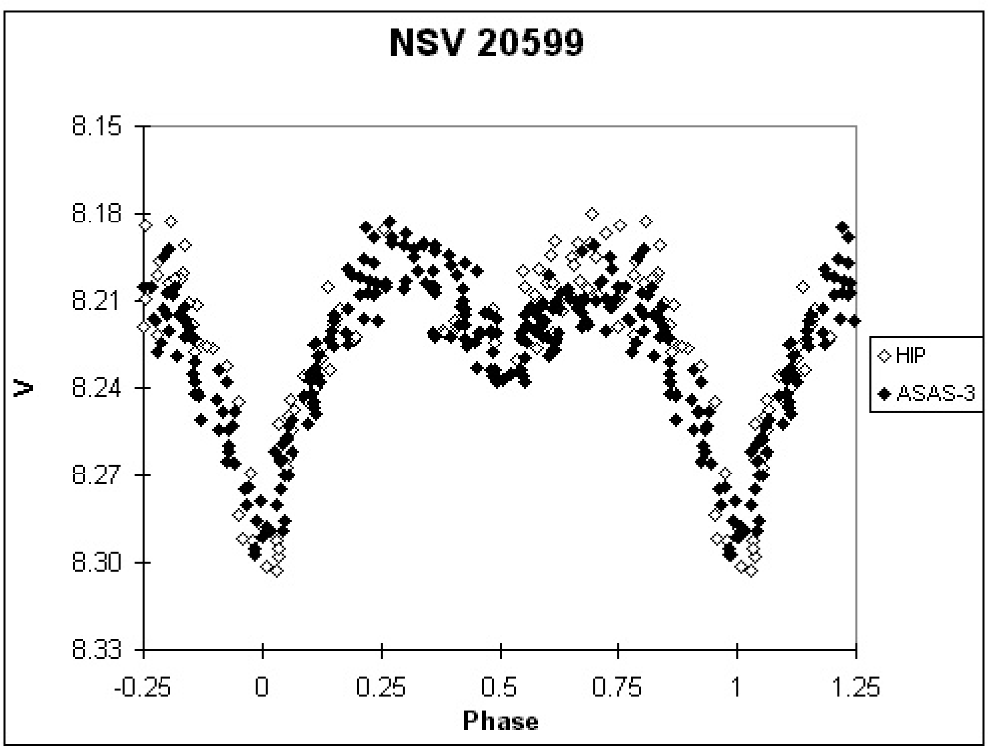

Figure 4. Light curve of NSV 20599 showing ASAS-3 and Hipparcos observations.

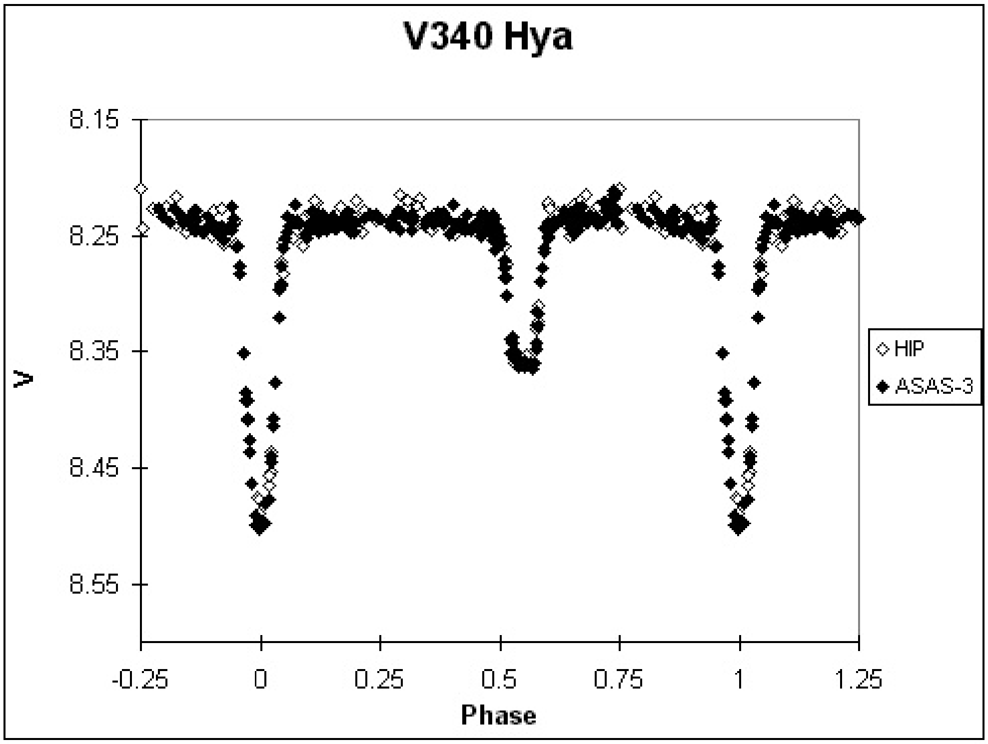

Figure 5. Light curve of V340 Hya showing ASAS-3 and Hipparcos observations.

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ERRATUM FOR IBVS 5586

The following information had been omitted from IBVS 5586:

Sources of spectral type (Table 1.): (1) Houk and Cowley, 1975. (2) Houk, 1978. (3) Houk, 1982. (5) Houk and Swift, 1999. (8) Kennedy, 1983. (9) Nesterov et al., 1995. (14) Kholopov et al., 2003. (17) Buscombe, 1998. (18) Buscombe, 1999. (24) Ochsenbein, 1980. (27) Grenier et al., 1999. (33) Cannon and Pickering, 1993. (36) Jaschek et al., 1964. (47) Jaschek, 1978. (48) Duflot et al., 1995. (50) Li and Hu, 1998.

ERRATUM FOR IBVS 5586

The EA/RS: star NSV 16225 published as HIP 32218 is actually HIP 23385 = HD 32218.

ERRATUM FOR IBVS 5586

Sebastian Otero reported the following error:

IBVS No.	item	printed	correct
5586	filter (NSV 15024)	13.20(12.80)	13.20(12.80)*

ERRATA FOR IBVS 5586

Geert Hoogeveen reported the following errors:

IBVS No.	item	printed	correct
5586	identifier (NSV 20599)	HIP 80022	HIP 80222
5586	identifier (NSV 1916)	GSC 8959-0532	GSC 1859-0532

COMMISSIONS 27 AND 42 OF THE IAU
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FIRST OPTICAL SPECTRA OF AD MENSAE

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The object has first been mentioned as a possible SS Cyg type star by Payne-Gaposchkin (1971), while she was investigating variable stars in the Large Magellanic Cloud. It was thus included as AD Men in the 69th name–list of variable stars (Kholopov et al. 1989). The first spectroscopic observation was performed by Zwitter & Munari (1995), who found the star about 1^{m} brighter than previously catalogued and concluded that AD Men might thus be a CV in outburst, probably a dwarf nova of SS Cyg subtype. This was in agreement with the A-type absorption spectrum without emission lines which they observed. Unfortunately, checking the coordinates, one realises, that they actually did not observe AD Men itself but a brighter star about 40 arcsec southwest of AD Men (Downes at al. 2001).

Since the object therefore still lacks spectroscopic confirmation of its classification as a CV, we performed new spectroscopic observations using the ESO Faint Object Spectrograph and Camera (EFOSC2) at the 3.6 m telescope on La Silla, Chile. Six spectra, each of 5 min exposure time, have been obtained on 2004-11-14 starting at 07:21 UT using grism #6 and a $1''$slit.

Standard reduction has been performed with IRAF. The BIAS has been subtracted and the data have been divided by a flat field, which was normalised by fitting Chebyshev functions of high order to remove the detector specific spectral response. The six spectra have been optimally extracted (Horne, 1986). Wavelength calibration yielded a final FWHM resolution of 1.2 nm and a spectral range of 390 nm to 790 nm. The individual spectra have then been averaged, the continuum of the final spectrum has been normalised to one.

The resulting spectrum is plotted in Fig. 1. It is dominated by the Balmer lines and some He I lines in emission. Also present is Fe II at 516.9 nm, but no indication for any high excitation lines like He II are found. The properties of the identified emission lines are listed in Table 1.

In order to derive information on the possible temperature range of the disc of AD Men, we have measured the Balmer decrement, which is defined as ratio of line intensities $H_\alpha : H_\beta : H_\gamma$. For the ratios of the equivalent widths we find $H_\alpha/H_\beta = 2.32$ and $H_\gamma/H_\beta = 0.59$. A comparison of the equivalent widths and their ratios with the model data from Williams (1991) yields moderately high temperatures and densities. Due to the rather low values of the equivalent widths, a high inclination has to be assumed for the system to get an agreement in all three lines. The best correspondence is found for $T = 8000$K, $\log N_0 = 12.5$, and an inclination of 80°, but a somewhat higher temperature and lower density ($T = 10000$K, $\log N_0 = 12.0$) is still in agreement with the data.

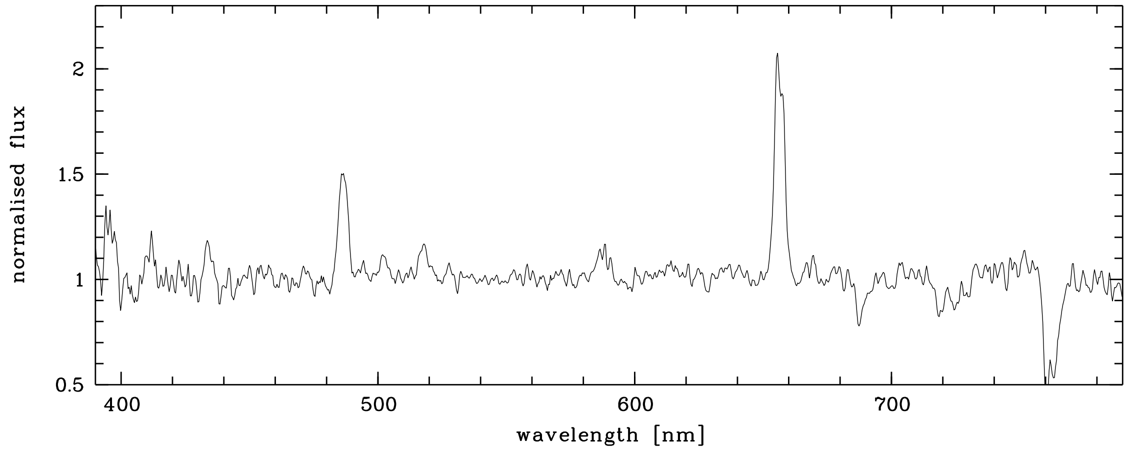

Figure 1. The normalised optical spectrum of AD Men, shows the system to be a cataclysmic variable of probably low mass transfer rate.

Table 1: Measured line width, computed velocity, and measured equivalent widths are given for all identified lines in the spectrum of AD Men.

Transition	λ [nm]	FWHM [nm]	$v_{\rm rot} \sin i$ [km s^{-1}]	$-W$ [nm]
Hα	656.2	4.55(4)	2080	5.1(2)
Hβ	486.1	3.96(3)	2440	2.2(1)
Hγ	434.0	3.49(8)	2410	1.3(4)
Hδ	410.2	3.54(8)	2590	0.8(2)
Hϵ	397.0	2.93(5)	2210	0.4(3)
He I	667.8	4.0(3)	1800	0.5(1)
He I	587.6	6.6(6)	3400	0.8(2)
He I	501.5	3.4(2)	2000	0.4(1)
Fe II	516.9	3.8(2)	2200	0.69(5)

The high Balmer decrement, the presence of HI and HeI emission lines and the absence of high excitation lines suggest that AD Men is a cataclysmic variable with rather low mass transfer rate. Our spectrum hence confirms the classification of AD Men as dwarf nova and does not contradict the SS Cyg subtype designation. The confirmation of the subtype has to come from long term photometric monitoring. Although the object is relatively bright (B $\approx 15\overset{\rm m}{.}5$), to our knowledge no such monitoring has been performed so far.

In average we find a projected rotation velocity of 2350 km/s. From this high value, we conclude that AD Men is seen at rather high inclination. This agrees with the relatively low values of the equivalent widths. The Balmer lines seem to be slightly broader than the He I or Fe II lines, thus indicating that the lines might origin in different regions of the accretion disc. However, the difference is not significant enough for any convincing conclusion, especially regarding the low S/N of the He I lines.

To check for variability, we analysed the individual spectra. We have six spectra covering about 0.6 h in total. Plotting the region around Hα for each individual spectrum (see Fig. 2) visualises the variability in the line. The line seems to consist of three peaks, indicating the presence of isolated emission sources in addition to the general disc emission. We measured the radial velocities of Hα by fitting a broad Gaussian and derive a variation between -150 km s^{-1} and $+100$ km s^{-1} (Fig. 2). Due to the short time–coverage only, we cannot make any assumptions on the orbital period. However, for the semi-amplitude of the radial velocities we find a lower limit of $K_1 > 120\,\mathrm{km\,s^{-1}}$. This variation is very high and thus again points toward the high inclination of the system.

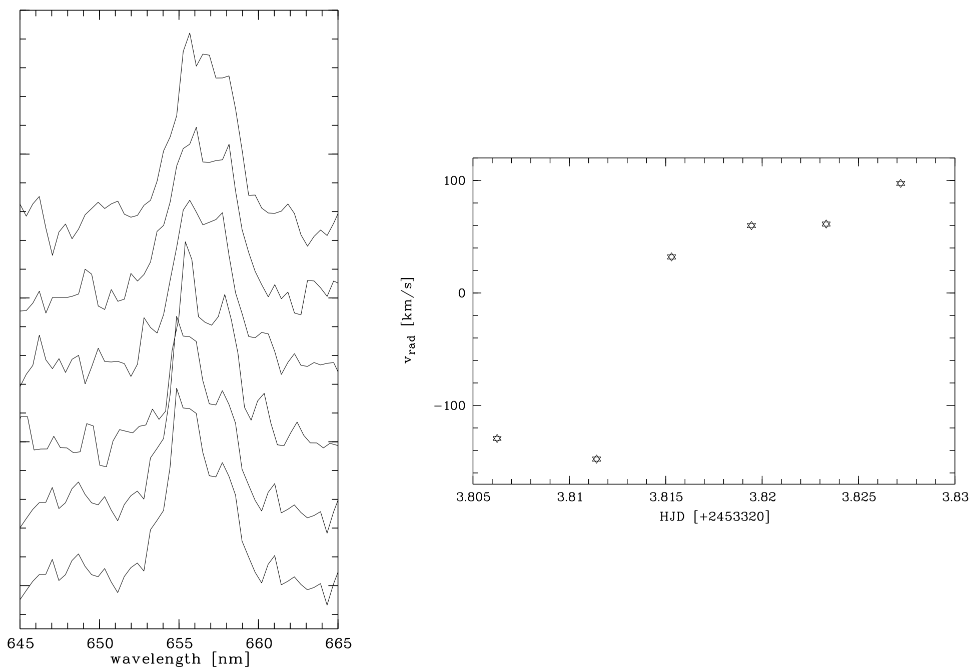

Figure 2. On the left side, the variation of Hα is visualised. The spectra with the continuum normalised to 1, are arbitrarily shifted up with increasing time. On the right side, the radial velocities as measured by fitting a broad Gaussian to the line are plotted against time.

We expect the system to have a period below the period gap for the following reasons: (1) for a system above the period gap, K_1 would reach values of $350\,\mathrm{km\,s^{-1}}$ or more. Such high values are rather unlikely, even eclipsing dwarf nova tend to have values between 90 and $200\,\mathrm{km\,s^{-1}}$ only. (2) The system is of low mass transfer rate, but no signs of the secondary are found in the spectrum. Hence, the secondary should be of rather low mass which results in a low orbital period. On the other hand, we do not see any absorption features of the white dwarf, thus excluding very low mass transfer rates, such as for WZ Sge type CVs. We therefore tentatively conclude that AD Men is a high inclination, possibly eclipsing SU UMa type dwarf nova with an orbital period below 2 h, making it an interesting target for followup time-resolved observations.

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4 January 2005

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PHOTOELECTRIC MINIMA OF SOME ECLIPSING BINARY STARS

AKSU, O.;ÖZAVCİ, I.; YÜCE, K.; TANRIVERDİ, T.; ŞENAVCI, H. V.; YILMAZ, M.; KARA, A.; KAYA, F.; HELVACI, M.; ÇETİNTAŞ, C.; ÇINAR, D.; ÖZUYAR, D.; BAŞTÜRK, Ö.; AYDIN, E.; ATLAGAN, Ö.; ŞENER, H. T.; KABADAYI, Ö.; YELKENCİ, K.; EVİN, B.

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Observatory and telescope:
30-cm Maksutov telescope of the Ankara University Observatory

Detector:	OPTEC SSP-5A photoelectric photometer (uncooled) containing a side-on R1414 Hamamatsu photomultiplier.

Method of data reduction:
Reduction of the observations were made in the usual way (Hardie, 1962).

Times of minima:

Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
V363 And	52925.3790	0.0007	II	*BV*	Ak-Yl
HV Aqr	53251.3796	0.0005	I	*UBV*	Özy-Mh
AR Aur	52995.4800	0.0004	II	*UBV*	Ak-Yl
AC Boo	53096.4708	0.0002	I	*UBV*	Tr-Gr
	53110.5685	0.0002	I	*UBV*	Öz-Al
CK Boo	53100.5902	0.0005	I	*UBV*	Çn-Gl
WY Cnc	53083.4377	0.0002	II	*BV*	Çt-Ky
	53100.4160	0.0005	I	*BV*	Ay-Gl
MR Cyg	53232.3607	0.0003	I	*UBV*	Kr-Kb
	53247.4543	0.0005	I	*UBV*	Çn-Ev
V687 Cyg	52925.3125	0.0003	I	*BV*	Yld-Çn
	53275.2874	0.0003	I	*UBV*	Km-At
V2150 Cyg	53229.4039	0.0007	I	*UBV*	Bn-Bş
AK Her	53238.3572	0.0002	I	*UBV*	Ylk-Ayd
V948 Her	53173.4690	0.0004	I	*BV*	Öz-Şnr
SW Lac	52958.4473	0.0002	I	*BV*	Tn-Şh
	53244.5265	0.0001	I	*BV*	En-Sğ
UZ Leo	53076.3932	0.0004	II	*UBV*	Çt-En
V508 Oph	53107.5741	0.0002	I	*BV*	Ev-Ay
V839 Oph	53207.4103	0.0002	II	*UBV*	Alp-Çl
V781 Tau	52959.4987	0.0003	I	*UBV*	Yl-Şn
	53040.3792	0.0003	II	*BV*	Öz-Şnr
AH Vir	53101.4282	0.0003	I	*UBV*	AkH-Atm
DR Vul	53252.3227	0.0004	I	*BV*	Özy-Ul

Explanation of the remarks in the table:
Observers: Ak: O. Aksu, AkH: H. Ak, Al: N. Alan, Alp: I. Alpay, At: Ö. Atlagan, Atm: E. Ataman, Ay: F. Aydoğan, Ayd: E. Aydın, Bn: F. Bingöl, Bş: Ö. Baştürk, Çl: T. Çolak, Çn: D. Çınar, Çt: C. Çetintaş, En: M.F. Engin, Ev: B. Evin, Gl: G. Gülnaz, Gr: G. Gürkan, Kb: Ö. Kabadayı, Km: S. Kösemen, Kr: A. Kara, Ky: F. Kaya, Mh: B. Mahmutoğlu, Özy: D. Özuyar, Öz: I. Özavcı, Sg: U. Sağır, Şnr: H.T. Şener, Şh: Şahin, Şn: H. V. Şenavcı, Tn: T. Tanrıverdi, Tr: E. Törün, Ul: C. Uluğ, Yl: M. Yılmaz, Yld: U. Yıldız, Ylk: K. Yelkenci

Acknowledgements:

This work was supported by the Turkish Academy of Sciences in the framework of the Young Scientist Award Program (BA/TÜBA-GEBİP/2001-2-2). Also we would like to thank to all observers at Ankara University Observatory.

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δ SCUTI LIKE PULSATION OF H254 USING ROTSE3D CCD OBSERVATIONS

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H254 is a pre-main sequence F0 spectral type star with T_{eff}= 7200 K and L_{bol}=31.4 $L_\odot$ (Luhman et al. 1998) in the young cluster IC 348. Ripepi et al. (2002) identified four frequencies for this source by using their eleven days observations. One of these frequencies was at 7.406 d^{-1} which is typical of δ Scuti type pulsators. They reported that the other three frequencies result from the long term behavior associated with a daily variation of H254 and partially with the similar variability in the comparison star H20.

We attempted to detect the light variations of H254 in our 95 days of observation span obtained with ROTSE3d telescope located at Bakırlıtepe, Turkey. ROTSE3 systems were described in detail in Akerlof et al. (2003). It operates without filters and has a wide passband which peaks at 550 nm. It is equipped with a CCD, 2048×2048 pixel, the pixel scale is 3.3 arcsec per pixel for a total field of view $1\overset{\circ}{.}85\times1\overset{\circ}{.}85$.

The observations were obtained between the nights MJD 53232 (August) and MJD 53327 (November). We were able to obtain 3 to 40 frames for IC 348 at each night, because of the other scheduled observations. The exposure time was 5 seconds. A total of about 1600 CCD frames were analysed. Aperture photometry by SExtractor (Bertin&Arnouts, 1996) were applied to the observed CCD frames to obtain the instrumental magnitudes. Then, ROTSE magnitudes were calculated by comparing all the field stars to the USNO A2.0 R-band catalog. All the processes were done in sequential automated mode. Barycentric corrections were made to the times of each observation by using JPL DE200 ephemerides. As a comparison star we chose H261 which is at a distance of 4′from H254. Its spectral type (F2) is not too different from the spectral type of H254.

Fig.1 shows ROTSE3d light curve ($\delta m_{ROTSE}= {m_{ROTSE}}^{254}$- ${m_{ROTSE}}^{261}$) obtained from CCD observations.

A Fourier analysis of data led to the detection of a signal for a frequency 7.406 d^{-1}. We used a period search programme written by M. Sperl (Period98: available at `www.astro.univie.ac.at/~dsn/`). Fig.2 (upper panel) shows the power spectrum of H254 which displays the frequency 7.406 d^{-1} with one day alias pattern. When this frequency is removed from the spectrum no other significant frequency is seen.

We also employed the method of Scargle (Scargle, 1982) for period search in order to evaluate the confidence levels of oscillations (see Fig.2 lower panel). We estimated the

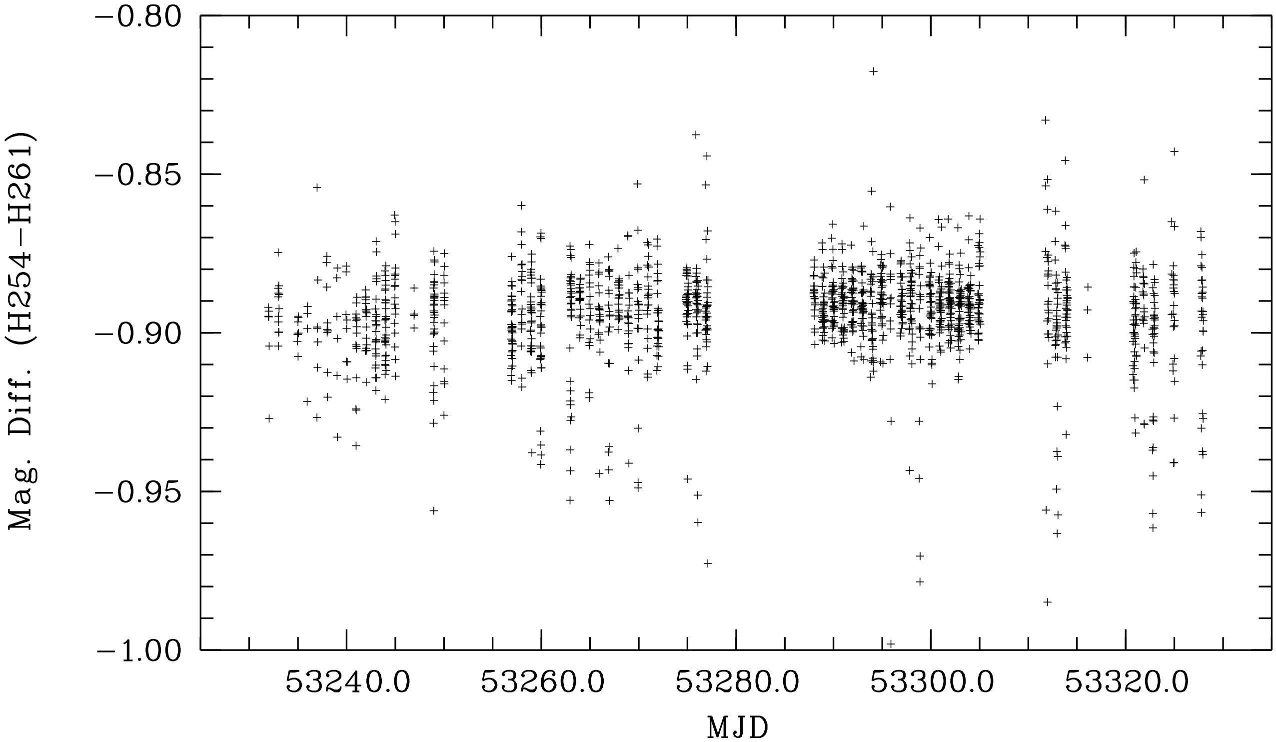

Figure 1. ROTSE3d light curve

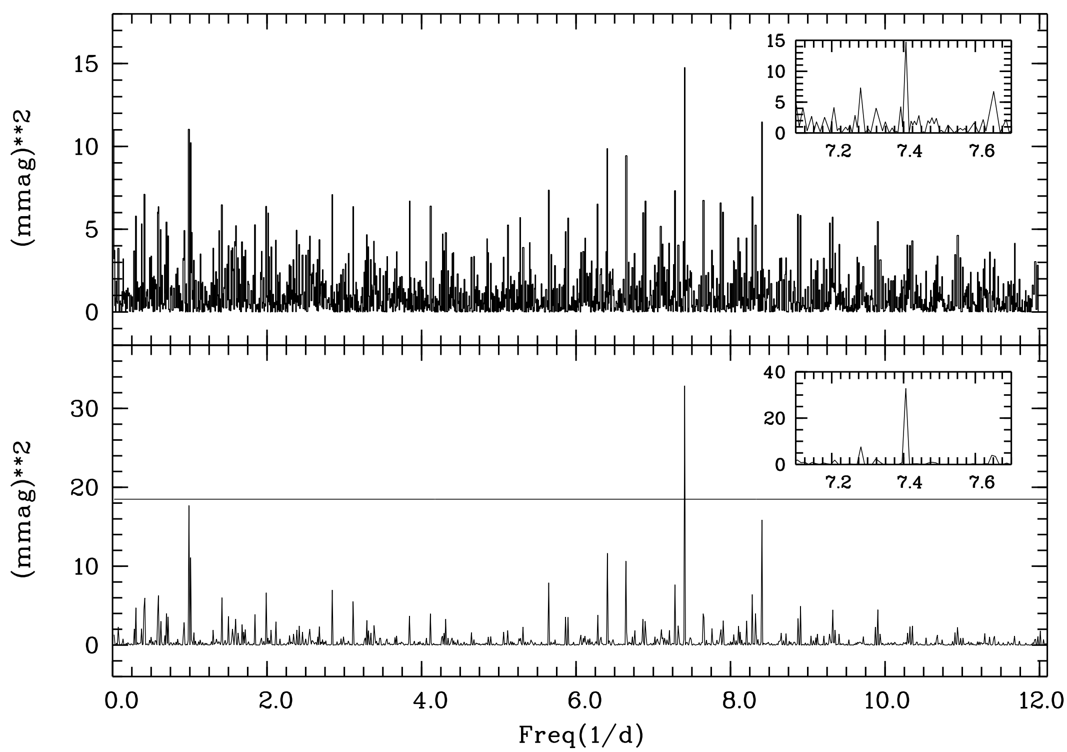

Figure 2. Power spectra for H254 (upper panel: Period98, lower panel: Scargle algorithm, MJD = JD − 2400000.5). Solid line represents 2σ confidence level.

noise level of periodogram by fitting a constant line. The probability of a signal above this level has an exponential probability distribution which is essentially a χ^2 distribution for two degrees of freedom (Scargle 1982). For given parameters, the confidence level of the signal for the maximum power at 7.406 d^{-1} is ~ 0.997. This confidence level is close to the $\sim 5\sigma$ level signal detection. As seen from Fig.2 all other detected powers are below the 2σ detection level which indicate that 0.157, 0.283 and 0.931 d^{-1} frequencies detected by Ripepi et al. (2002) are not present in our light curve.

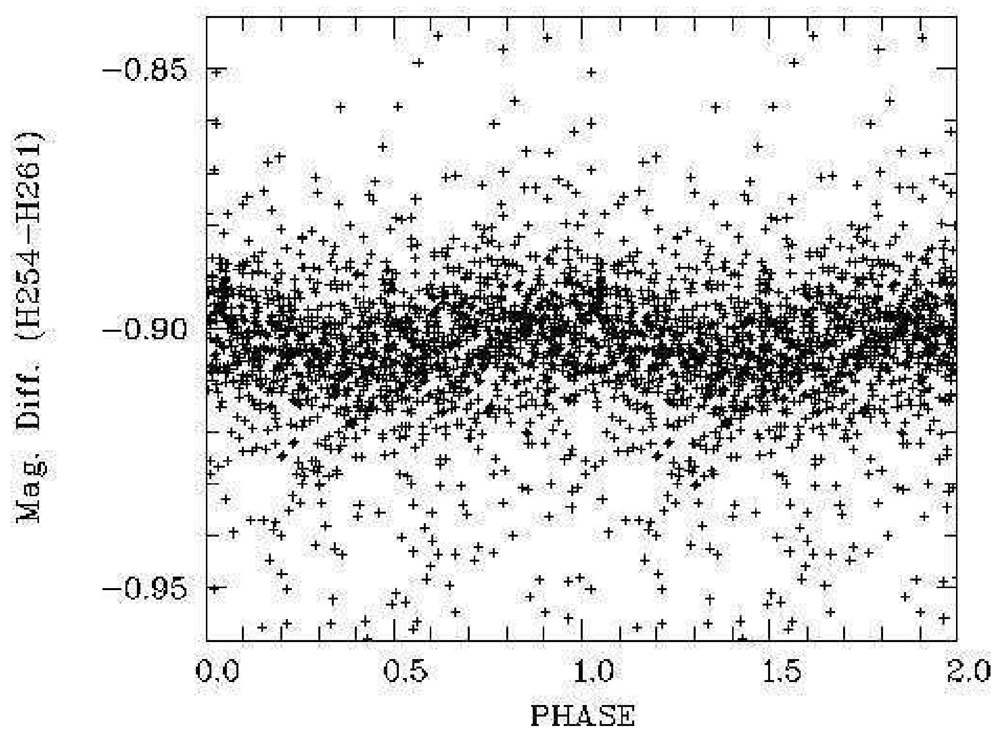

Figure 3. Light curve phased with the frequency 7.406 d^{-1}

Fig.3 shows the light curve phased with the frequency 7.406 d^{-1}.

As a conclusion, ROTSE3d data allowed us to identify the frequency 7.406 d^{-1}. No other significant frequency was detected.

Acknowledgements:

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THE 2004 OPTICAL OUTBURST OF V635 Cas USING ROTSE3D OBSERVATIONS

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V635 Cas (B0.2Ve spectral type as adopted by Negueruela and Okazaki (2001)) is the optical counterpart of the X-ray transient 4U 0115+63. The optical outbursts reported by several observers (Kriss et al. 1983, Mendelson & Mazeh 1991) were thought to be connected with mass loss from the Be star. The optical outbursts usually precede the X-ray outbursts. A viscous circumstellar disc around the Be star and an accretion disc around the neutron star are proposed to explain the optical outbursts and the X-ray behaviour of the system (Negueruela and Okazaki 2001, Negueruela et al. 2001, Kriss et al. 1983).

Optical observations of V635 Cas were obtained between MJD 53180 (June) and MJD 53360 (December) using ROTSE3d telescope located at Bakırlıtepe, Turkey. ROTSE3 systems were described in detail in Akerlof et al. (2003). It operates without filters and has a wide passband which peaks at 550 nm.

A total of about 1700 CCD frames were analysed. After finding the instrumental magnitudes (Bertin & Arnouts, 1996) ROTSE magnitudes were calculated by comparing all the field stars to the USNO A2.0 R-band catalog. All the processes were done in sequential automated mode. Barycentric corrections were made to the times of each observation by using JPL DE200 ephemerides.

Fig.1 shows the data for V635 Cas obtained with ROTSE3d telescope. The difference in ROTSE magnitudes of V635 Cas and comparison star (RA= $01^h17^m35^s\!.7$, $\delta= +63°41'44''$) were plotted. As a check star we used the one with RA= $01^h18^m31^s\!.3$, $\delta= +63°47'30''\!.4$. On the same figure August 2004 X-ray outburst data (daily averages in counts per second) of this binary system obtained with the All Sky Monitor on board RXTE, were plotted. In the figure, the periastron passage time is also indicated with its uncertainty (Bildsten et al., 1997). A sinusoidal fit to the optical light curve gives a period of almost 300 days. Its amplitude is nearly 1 magnitude. The X-ray activity seems to appear about 180 days after the onset of the optical outburst, when V635 Cas light output reaches its maximum value. There is a gap in the ASM light curve between MJD 53223-53251. Interpolation of this gap suggests that X-ray outburst starts right after the sudden decrease of optical light without any significant delay. This decrease of the optical luminosity may be related with episodic mass transfer events from Be star to the compact object accompanied by

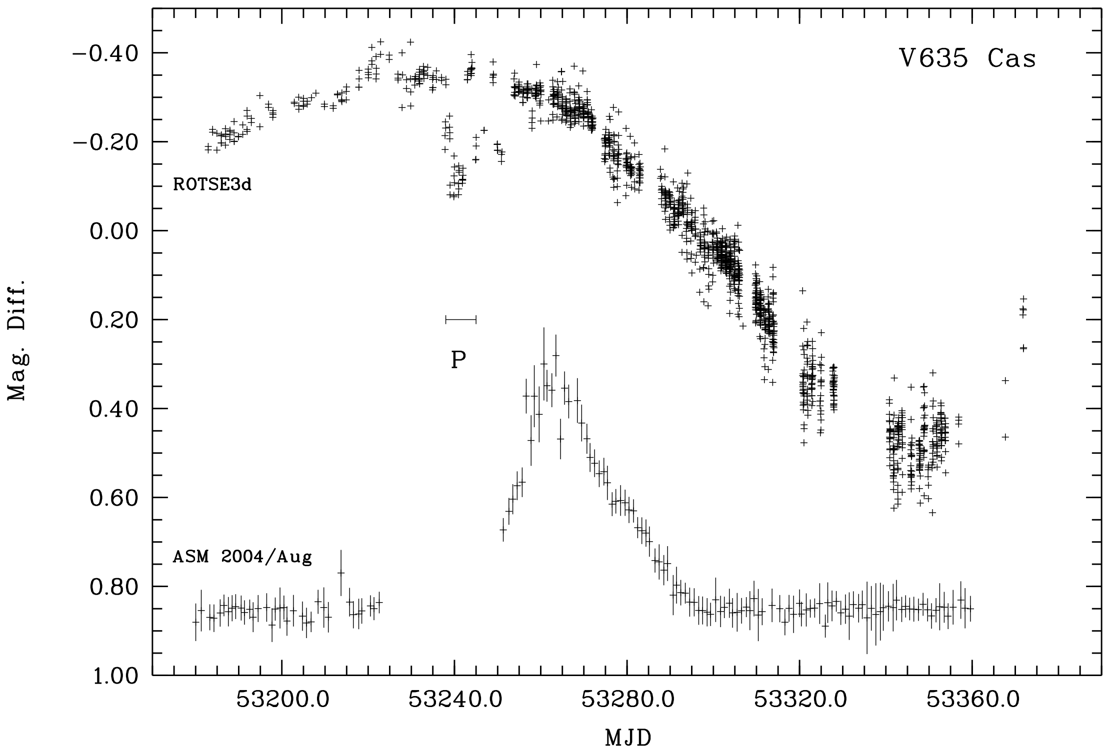

Figure 1. ROTSE3d light curve for V635 Cas and X-ray light curve of this binary system taken with ASM (points represent daily averages, MJD = JD − 2400000.5).

triggering X-ray outburst. Afterwards the optical counterpart begins to fade. At about MJD 53350 there seems a beginning of a new period of optical outburst.

Further ROTSE observations of this source is in progress.

Acknowledgements:

This study was supported by TUG (Turkish National Observatory), TUBITAK (Turkish Scientific and Research Council).

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A PHOTOMETRIC INVESTIGATION OF A CLOSE BINARY SYSTEM: YY Cnc

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YY Cnc (BD+31 1838, V_{max}=11.3 mag) was discovered by Hoffmeister (1949). Coordinates and identification for this and other Sonneberg variables in the MVS 308-316 were given by Kinnunen and Skiff (2000). The third edition of the General Catalogue of Variable Stars gives only the epoch of the primary minimum and the period of 0.55 days. The spectral type is listed as F2 both in the GCVS and the ADS database.

We present first ever obtained photometric light curves taken at the Mt. Suhora Observatory with the 60 cm telescope and a three channel photometer equipped with the wide-band UBVR filters. The observations were gathered from 11/12 to 24/25 Feb 2003. GSC 2483 1211 was used as the comparison star. Additionally, to enlarge the time span, the primary minimum was observed with the same telescope and a SBIG ST10/XME CCD camera about a year later on January 27/28, 2004, and again with the three channel photometer on February 25/26, 2004. All measurements have been corrected for differential extinction and left in the instrumental, close to the Johnson-Morgan, system. We observed 5 primary and 1 secondary eclipses and determined their times using the Kwee-van Woerden method. These times are shown in Table 1. We found the period significantly longer than that listed in the GCVS. Using the new times of minima we determined a new linear ephemeris for YY Cnc:

$$\mathrm{HJD}_{\mathrm{prim.min.}}=2452695.5815(3) + 0.698448(2) * E$$

Table 1. New times of minima for YY Cnc

No.	Date	type	Time of minimum	Instrument
1	12/13-02-2003	sec	2452683.3464(3)	p3ch
2	13/14-02-2003	prim	2452684.4056(3)	p3ch
3	24/25-02-2003	prim	2452695.5811(3)	p3ch
4	27/28-03-2003	prim	2452726.3150(4)	p3ch
5	26/27-01-2004	prim	2453031.5443(9)	CCD
6	25/26-02-2004	prim	2453061.5680(4)	p3ch

The observations were phased with the new ephemeris and we attempted to obtain a preliminary model for this star using the Wilson-Devinney code (Wilson 1979, 1993). In the first step we assumed the primary temperature to be 6700 K as corresponding to the F2 spectral type (6700 K, Harmanec 1988) and made a search for the best fit with the Monte Carlo algorithm. Theoretical values for the albedo and gravity darkening coefficients, appropriate for a convective envelope were assumed. The coefficients for the limb darkening were taken as functions of the temperature and wavelength from Díaz-Cordovés et al. (1995) and Claret et al. (1995) tables. We assumed that there is no third light in this system. Computations were done simultaneously for the BVR filters. Observations in the U filter were discarded due to their bigger scatter. With such assumptions the convergence was very slow and we performed more computations for a grid of the primary temperature between 6500 K and 10000 K with a 500 K step. It soon turned out that for higher temperatures the solutions converged very fast and we were able to obtain a better fit to observations, with the best solution for the primary temperature being 7500 K. The fits for both models (that for the primary temperature corresponding to the F2 spectral type (T_1=6700 K) is denoted by the dashed line and that for 7500 K by the solid line) are shown in Fig. 1, while the resulting parameters are presented in Table 2. Asterisks denote assumed parameters, while double asterisks mark those which were not adjusted but computed by the Wilson-Devinney code.

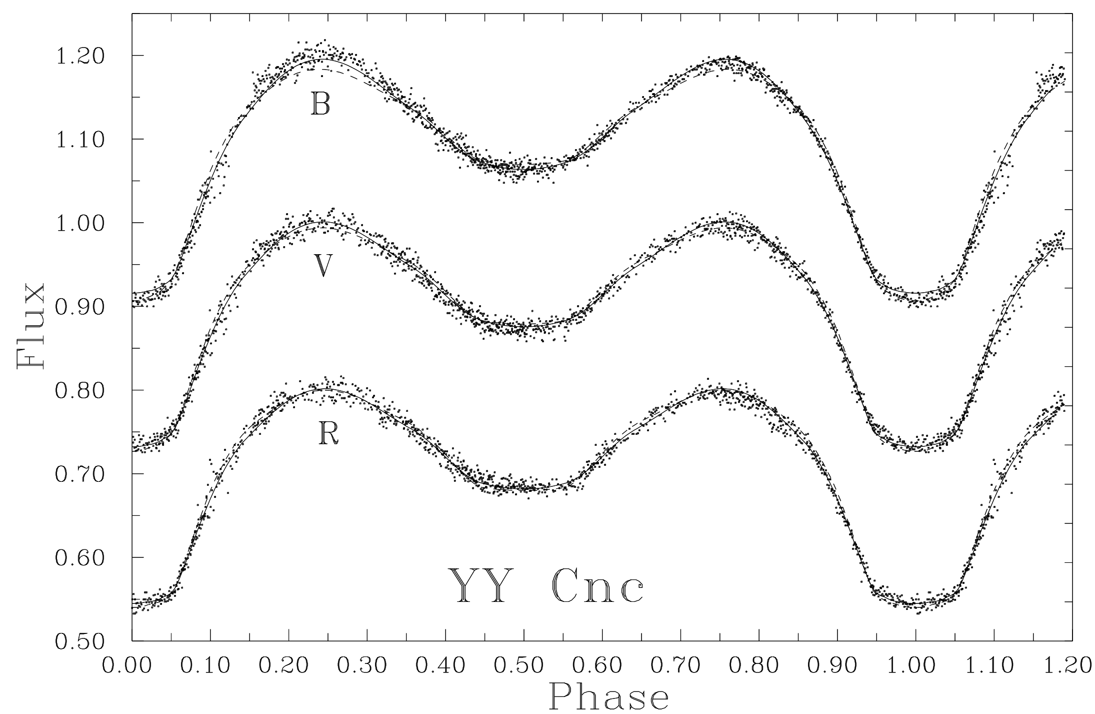

Figure 1. Comparison between observed (points) and theoretical (lines) light curves.

A significantly better fit (as measured by the χ^2) was obtained for somewhat higher temperature of the primary component than that corresponding to the F2 spectral type listed for YY Cnc in the GCVS.

Both solutions indicate YY Cnc to be a close system with the hotter component almost filling its Roche lobe. The secondary component is well inside its Roche lobe. The system inclination is close to 90 degrees. The mass ratio is low, about 0.2 for both solutions, regardless of the assumed temperature of the hotter component, as may be indicated by the flat bottom shape of the secondary minimum. However, only spectroscopic observations could confirm our results derived on the basis of photometric measurements only.

Table 2. Results derived from the light curve modelling

parameter	model 1 (T_1=6700 K)	model 2 (T_1=7500 K)
configuration	semi-detached	detached
phase shift	-0.0006 ± 0.0002	-0.0003 ± 0.0002
i (degrees)	87.71 ± 0.10	89.45 ± 1.03
T_1(K)	* 6700	* 7500
T_2(K)	4510 ± 30	4010 ± 40
Ω_1	2.237 ± 0.012	2.182 ± 0.014
Ω_2	2.395 ± 0.030	2.256 ± 0.029
$q_{phot}(m_2/m_1)$	*0.20 ± 0.01	0.18 ± 0.01
L_1 (*B*)	12.243 ± 0.009	12.864 ± 0.016
L_1 (*V*)	12.209 ± 0.009	12.819 ± 0.013
L_1 (*R*)	12.164 ± 0.009	12.715 ± 0.012
L_2 (*B*)	** 0.222	** 0.051
L_2 (*V*)	** 0.292	** 0.093
L_2 (*R*)	** 0.362	** 0.140
χ^2	781.5	271.6

Acknowledgments

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PHOTOELECTRIC MINIMA OF SOME ECLIPSING BINARY STARS

KRAJCI, TOM

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Observatory and telescope:
All observations were conducted in Tashkent, Uzbekistan from an urban yard under moderate light pollution. 28cm Schmidt-Cassegrain, 2640 mm focal length. German equatorial mount.

Detector:	SBIG ST-7E, $-15\,^{\circ}$C, covering 8×5 arcminutes, 18 micron pixels (binned 2×2). Unfiltered.

Method of data reduction:
All CCD frames calibrated with bias, dark, and flat frames using AIP4WIN software. Differential aperture photometry performed using AIP4WIN software. AIP4WIN software available at: `http://www.willbell.com/aip/index.htm`

Method of minimum determination:
Digital tracing paper method, bisection of chords, curve fitting, and (occasionally) Kwee and van Woerden (1956).

Times of minima:

Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
RT And	52893.4306	0.0001	I	None	
UU And	52925.4253	0.0001	I	None	
AA And	52968.2774	0.0001	I	None	
AB And	52880.4065	0.0000	I	None	
BX And	52932.3042	0.0001	I	None	
DS And	53023.1223	0.0001	I	None	
GZ And	52926.3818	0.0001	II	None	
DD Aqr	52894.3830	0.0001	I	None	
SS Ari	52888.4068	0.0002	I	None	
EM Aur	53038.2170	0.0003	I	None	
LY Aur	53046.1756	0.0009	I	None	
MU Aur	53067.2440	0.0003	I	None	
V410 Aur	53058.1464	0.0001	II	None	
V410 Aur	53108.1552	0.0001	I	None	
TU Boo	53167.2125	0.0002	I	None	
TX Boo	53125.2491	0.0010	I	None	
TX Boo	53159.3796	0.0005	I	None	
XY Boo	53105.2519	0.0005	I	None	
AR Boo	53090.4682	0.0001	I	None	
AR Boo	53143.2339	0.0003	I	None	
EF Boo	53163.1677	0.0002	II	None	
ET Boo	53105.3887	0.0003	I	None	
FI Boo	53149.2994	0.0003	I	None	

Times of minima:					
Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
GS Boo	52843.1540	0.0011	I	None	
GS Boo	53045.5019	0.0001	I	None	
GS Boo	53142.2768	0.0002	I	None	
AO Cam	53083.2119	0.0002	II	None	
XZ Cnc	53087.3199	0.0002	I	None	Correct period $0\overset{d}{.}714673$
AH Cnc	53047.3702	0.0003	I	None	
EV Cnc	53108.2776	0.0008	I	None	
EV Cnc	53109.1864	0.0007	I	None	
RV CVn	53148.2594	0.0002	I	None	
BI CVn	53047.5749	0.0010	I	None	
DK CVn	53082.4493	0.0005	I	None	
DM CVn	53166.2016	0.0002	I	None	
TY CMi	53075.2212	0.0004	I	None	
TV Cas	52962.1273	0.0001	I	None	
TW Cas	52929.3367	0.0001	I	None	
TW Cas	53032.1751	0.0002	I	None	
BH Cas	52889.3778	0.0001	I	None	
BS Cas	52927.3109	0.0003	II	None	
CW Cas	52928.3973	0.0012	II	None	
CW Cas	52884.3950	0.0002	II	None	
V364 Cas	52930.3319	0.0001	I	None	
V389 Cas	52931.3774	0.0001	I	None	Also known as GSC 3272-0316
V523 Cas	52922.4218	0.0000	I	None	
V776 Cas	53086.1374	0.0001	I	None	
V860 Cas	52892.4095	0.0003	I	None	
GS Cep	52890.3524	0.0001	I	None	
GW Cep	52935.3199	0.0001	II	None	
IP Cep	52953.1033	0.0002	I	None	
NS Cep	52912.1447	0.0001	I	None	Also known as HBV 480
SS Com	53050.4044	0.0004	I	None	
AQ Com	53123.2660	0.0005	II	None	
CN Com	53164.2941	0.0006	I	None	
DD Com	53124.2241	0.0008	I	None	
DD Com	53124.3566	0.0008	II	None	
EK Com	53066.4462	0.0001	I	None	
EQ Com	53153.2397	0.0003	I	None	
KR Com	53058.4796	0.0002	II	None	
KR Com	53150.2695	0.0005	II	None	
TU CrB	53091.4393	0.0001	I	None	
CG Cyg	52963.1454	0.0001	I	None	
V345 Cyg	52890.1978	0.0002	I	None	
V401 Cyg	52914.1135	0.0001	I	None	
V753 Cyg	52889.1513	0.0001	I	None	
V859 Cyg	52894.1433	0.0001	I	None	
V1004 Cyg	52900.2096	0.0002	I	None	
V2287 Cyg	52893.3167	0.0002	I	None	
V2287 Cyg	53157.4455	0.0007	I	None	
V2290 Cyg	52849.3049	0.0001	I	None	
V2290 Cyg	53124.4724	0.0009	I	None	
RZ Dra	52895.1732	0.0003	I	None	
BH Dra	52913.1026	0.0001	I	None	
BV Dra	53092.4514	0.0001	II	None	
BV Dra	53099.4507	0.0002	II	None	
BW Dra	53099.4236	0.0002	II	None	
LQ Dra	52923.1133	0.0001	I	None	
LQ Dra	53140.4261	0.0001	I	None	
WW Gem	53055.2027	0.0002	I	None	
AL Gem	53045.1617	0.0003	I	None	
DG Gem	53111.1930	0.0004	I	None	
GP Gem	53106.1880	0.0002	II	None	

Times of minima:

Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
QW Gem	53057.2714	0.0001	II	None	
V687 Her	53159.2786	0.0002	I	None	
V731 Her	53123.3805	0.0007	II	None	Correct period $0\overset{d}{.}426408$
V878 Her	52859.1761	0.0002	I	None	
V878 Her	53115.4406	0.0002	I	None	
V921 Her	53095.3998	0.0025	II	None	
V1024 Her	52831.1936	0.0001	I	None	
V1024 Her	52835.1747	0.0001	II	None	
V1024 Her	52839.1573	0.0015	I	None	
V1024 Her	53110.4081	0.0001	I	None	
V1034 Her	52873.1962	0.0003	I	None	
V1034 Her	53130.4213	0.0005	II	None	
V1042 Her	52867.1862	0.0002	I	None	
V1042 Her	53126.3407	0.0002	I	None	
V1050 Her	52864.3044	0.0002	I	None	
V1050 Her	52884.1899	0.0004	II	None	
V1050 Her	53126.4223	0.0005	I	None	
V1065 Her	52866.1739	0.0001	I	None	
V1065 Her	53118.3969	0.0002	I	None	
FG Hya	53105.1573	0.0003	II	None	
SW Lac	52883.3986	0.0001	I	None	
VX Lac	52887.4208	0.0001	I	None	
VX Lac	52899.2407	0.0000	I	None	
CO Lac	52968.1442	0.0001	I	None	
BL Leo	53133.1551	0.0010	I	None	
BL Leo	53140.2021	0.0002	I	None	
BV Leo	53165.2123	0.0007	II	None	
BV Leo	53173.2081	0.0005	I	None	
BW Leo	53158.1848	0.0012	I	None	
CE Leo	53172.1915	0.0002	II	None	
ET Leo	53141.2250	0.0004	II	None	
EX Leo	53067.3696	0.0001	I	None	
FS Leo	53082.3585	0.0003	I	None	
UU Lyn	53123.1899	0.0002	I	None	
CC Lyn	53084.2625	0.0015	I	None	
CD Lyn	53053.2446	0.0001	II	None	
DF Lyr	53105.4761	0.0006	I	None	
IP Lyr	53137.3919	0.0002	I	None	
NY Lyr	52889.2492	0.0001	I	None	
QU Lyr	52911.1152	0.0002	I	None	
V531 Lyr	52921.1501	0.0001	I	None	
V576 Lyr	52837.2083	0.0001	I	None	
V576 Lyr	52841.2096	0.0002	II	None	
V576 Lyr	52849.2132	0.0002	II	None	
V576 Lyr	53111.4643	0.0012	I	None	
V582 Lyr	52840.3612	0.0000	I	None	
V582 Lyr	52840.2340	0.0001	II	None	
V582 Lyr	53136.4436	0.0002	I	None	
V396 Mon	53055.1282	0.0001	I	None	
V442 Mon	53109.1384	0.0003	I	None	
V448 Mon	53094.2235	0.0015	II	None	
V450 Mon	53056.1414	0.0004	I	None	
V528 Mon	53090.2114	0.0001	I	None	
V2357 Oph	53158.3416	0.0005	I	None	
V2553 Oph	52820.2345	0.0001	I	None	
V2553 Oph	52823.2090	0.0001	II	None	
V2553 Oph	53112.4254	0.0020	II	None	
V2553 Oph	53125.4623	0.0002	I	None	
FZ Ori	52921.4942	0.0002	II	None	
GU Ori	53047.1311	0.0002	II	None	

Times of minima:					
Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
V343 Ori	53050.1305	0.0004	I	None	
U Peg	52885.3989	0.0001	I	None	
BX Peg	52886.3935	0.0001	I	None	
DI Peg	52888.3606	0.0001	I	None	
DP Peg	52867.2415	0.0001	I	None	
KW Peg	52886.3522	0.0002	I	None	
IU Per	53028.1419	0.0001	I	None	
V432 Per	52924.3608	0.0001	I	None	
V432 Per	53022.1057	0.0009	I	None	
LX Ser	53146.2310	0.0003	I	None	
OU Ser	53094.3375	0.0018	II	None	
Y Sex	53091.2258	0.0001	II	None	
CR Tau	53110.1262	0.0008	II	None	
EQ Tau	52923.4083	0.0000	I	None	
HU Tau	53066.1681	0.0001	I	None	
V781 Tau	53038.1373	0.0004	I	None	
V1154 Tau	52924.4763	0.0001	I	None	
V1154 Tau	53064.1402	0.0006	I	None	
RV Tri	53049.1708	0.0001	I	None	
TY UMa	53151.2419	0.0003	I	None	
XY UMa	53112.2409	0.0002	I	None	
AW UMa	53086.3908	0.0001	II	None	
BM UMa	53092.3840	0.0001	I	None	
BQ UMa	53168.2524	0.0010	II	None	
HN UMa	53096.4040	0.0004	I	None	
HX UMa	53057.4504	0.0007	I	None	
II UMa	53064.3778	0.0002	I	None	
LO UMa	53038.3828	0.0002	I	None	
LO UMa	53157.1601	0.0010	I	None	
RZ UMi	53135.3156	0.0004	I	None	
DY Vir	53118.2316	0.0003	I	None	
HT Vir	53087.5083	0.0001	II	None	
KZ Vir	53110.2639	0.0009	I	None	
NN Vir	53130.2446	0.0004	II	None	
BO Vul	52893.1873	0.0000	I	None	
NSV 24968	52847.2952	0.0001	I	None	

Remarks:

Correct period of XZ Cnc is 0.714673d. At time of publication GCVS period for this star is listed as 1.113753d, but this appears to be an aliasing artifact.

Correct period of V731 Her is 0.426408d. At time of publication GCVS period for this star is listed as 0.542d, but this appears to be an aliasing artifact.

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I'd like to thank the members of the AAVSO Eclipsing Binary Team for their advice and feedback in the preparation of this paper. This research has made use of the SIMBAD database, operated at CDS, Strasbourg, France (see references).

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STScI Digitized Sky Survey, http://archive.stsci.edu/cgi-bin/dss_form

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FOUR NEW SOUTHERN DOUBLE-MODE RR LYRAE STARS

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Double-mode pulsators, and double-mode RR Lyrae stars (type RRd) in particular, are very important in the study of pulsation models. Although they are abundant in the Magellanic Clouds (Alcock et al., 2000) and Galactic globular clusters (e.g. Walker and Nemec, 1996), very few Galactic Field RRd stars are known. The online edition of the General Catalogue of Variable Stars (GCVS, Kholopov et.al., 2003) only lists five RRd stars (new GCVS type RR(B)). A few other field and faint Galactic Bulge RRd stars have been discovered since, but there is still an apparent lack of relatively bright RRd stars in the Southern hemisphere and with negative Galactic latitudes.

By examining the publicly available data for the Southern RR Lyrae stars discovered by the *ASAS3* survey (Pojmanski, 2002), we found four previously unknown double-mode RR Lyrae stars.

Table 1 lists fundamental light curve parameters for the four stars, derived from the *ASAS3* data. It includes values for the invariant Fourier parameters and for the generalized phase differences $G_{1,1}$ and $G_{-1,1}$ of the cross coupling terms $f_0 + f_1$ and $f_1 - f_0$ respectively as defined by Poretti and Pardo (1997). Formal errors are given between parentheses in units of the last significant decimal. Also listed are the Galactic latitude b in degrees, the total proper motion μ derived from the *UCAC2* catalogue (Zacharias et al., 2004), and *Tycho-2* (Høg et al., 2000) and *2MASS* (Cutri et al., 2003) colour indices. The electronic version of the IBVS contains direct links to the *ASAS3* source data.

GSC 4868-0831 is the brightest RRd star known thus far. The amplitude of the first overtone is much higher than that of the fundamental mode for this star. For the other stars the amplitudes of both modes are more alike.

For GSC 7411-1269 the additional cross-coupling frequencies $2f_0 + f_1$, $f_0 + 2f_1$ and $2f_0 + 2f_1$ are present in the power spectrum.

GSC 8403-0647 is the Southern component of a close pair separated by $11''$, which the *ASAS3* camera cannot resolve. The *ASAS3* average position is in fact about midway between the two stars, but slightly closer to GSC 8403-0647 (40% of the distance), so that the latter is most probably the brightest of the two in V. This is confirmed by their *UCAC2* magnitudes. The *2MASS* catalogue indicates that the companion is slightly brighter in near infrared wavelengths (J = 11.94 compared to J = 12.01), but is also much redder with $J - K_s = 0.62$. Due to its redness, it is unlikely that the companion is the RR Lyrae variable. The pair is most probably physically unrelated, as shown by their *UCAC2* proper motions.

Table 1: Characteristics of the four new double mode RR Lyrae stars

Star	GSC 4868-0831	GSC 7411-1269	GSC 8403-0647	GSC 8936-2145
V_{ASAS3}	10.45−11.05	11.95−13.00	12.05−12.80	12.25−13.25
HJD Maximum	2452940.85	2452789.60	2453108.83	2452614.70
Period F (d)	0.56391(11)	0.46126(7)	0.46781(6)	0.51721(9)
Period 1O (d)	0.42079(6)	0.34247(4)	0.34778(4)	0.38521(5)
Period ratio	0.7462(2)	0.7425(1)	0.7434(1)	0.7448(2)
R_{21}(F)	0.11(4)	0.20(2)	0.17(4)	0.23(3)
R_{21}(1O)	0.21(2)	0.18(2)	0.19(4)	0.14(2)
Φ_{21}(F)	4.00(19)	4.10(8)	3.91(23)	3.95(10)
Φ_{21}(1O)	4.90(7)	4.82(4)	5.05(11)	4.68(4)
Amplitude ratio 1O/F	2.45(10)	0.98(2)	1.05(6)	1.37(5)
$G_{1,1}$	4.26(8)	4.01(2)	4.28(10)	3.99(9)
$G_{-1,1}$	3.68(8)	3.88(7)	3.35(21)	3.86(5)
b	+23.8	−11.8	−30.7	−17.0
μ (mas/yr)	54.6(1.7)	36.2(2.3)	13.7(3.0)	28.2(4.6)
$(B-V)_T$	0.41	−0.30	−0.07	–
$J-K_s$	0.30(3)	0.30(4)	0.23(4)	0.31(3)

The plots in Figs. 1 to 8 give for each of the stars the phase diagram for the fundamental mode and the first overtone mode, in both cases prewhitened for the other mode and its harmonics.

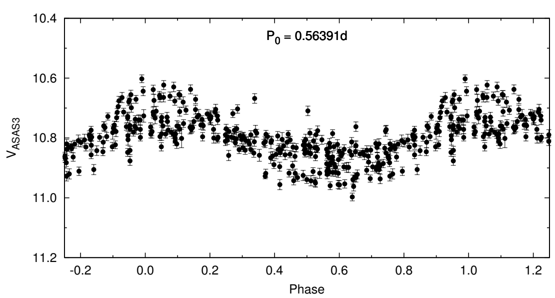

Figure 1. ASAS3 phased light curve for the fundamental period of GSC 4868-0831.

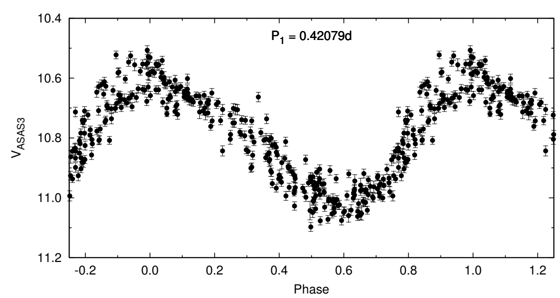

Figure 2. ASAS3 phased light curve for the first overtone period of GSC 4868-0831.

Acknowledgements: This research has utilised the *ASAS3* public photometry catalogue and the SIMBAD and VizieR databases operated at the *Centre de Données Astronomiques (Strasbourg)* in France. Use was made of the data products from the *Two Micron All Sky Survey*, which is a joint project of the University of Massachusetts and the Infrared Processing and Analysis Center/California Institute of Technology, funded by the National Aeronautics and Space Administration and the National Science Foundation. John Greaves is acknowledged for helpful suggestions and comments.

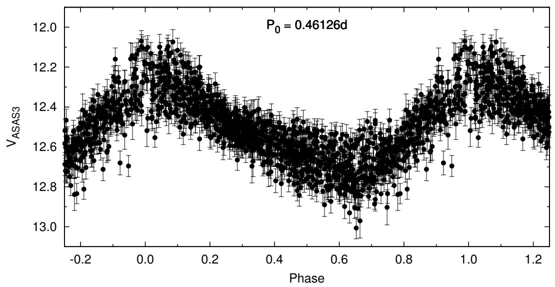

Figure 3. ASAS3 phased light curve for the fundamental period of GSC 7411-1269.

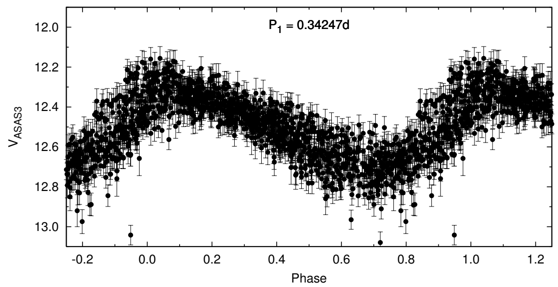

Figure 4. ASAS3 phased light curve for the first overtone period of GSC 7411-1269.

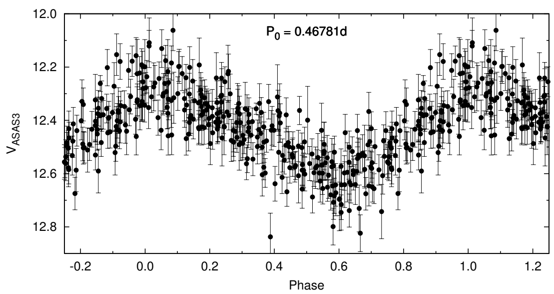

Figure 5. ASAS3 phased light curve for the fundamental period of GSC 8403-0647.

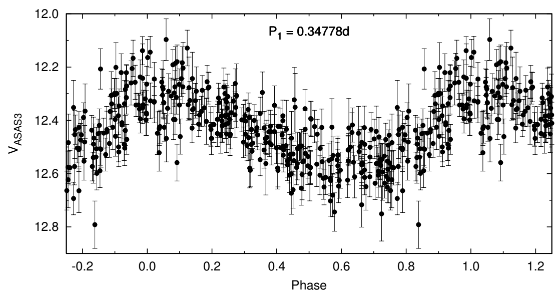

Figure 6. ASAS3 phased light curve for the first overtone period of GSC 8403-0647.

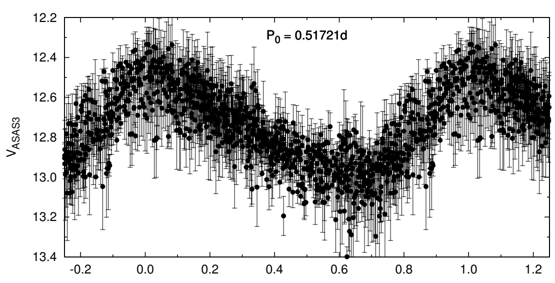

Figure 7. ASAS3 phased light curve for the fundamental period of GSC 8936-2145.

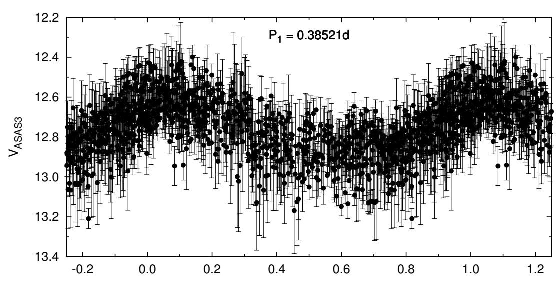

Figure 8. ASAS3 phased light curve for the first overtone period of GSC 8936-2145.

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PRECISE CCD TIMES OF MINIMA OF SELECTED ECLIPSING BINARIES

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Observatory and telescope:
0.65-m Cassegrain telescope, Ondřejov Observatory, Czech Republic

Detector:	512 × 512 Apogee AP-7 CCD camera in primary focus, Peltier cooled

Method of data reduction:
Reduction of the CCD frames was made with a APHOT32 code, ver.1.12, written by M. Velen & P. Pravec, Ondřejov Observatory

Method of minimum determination:
The precise times of minimum light were computed using the light-curve polynomial fitting method.

Availability of the data:
Upon request, see also `http://nyx.asu.cas.cz/~lenka/dbvar/`

Remarks:
The following Table lists 50 timings of minima of 42 eclipsing binaries obtained between April 2001 and November 2002 during our supplementary photometric programme or student's exercises in CCD photometry. The number of CCD frames analysed for each data set is given in the last column of the Table.

Times of minima:

Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
UU And	52549.3826	0.0001	I	R	30
CN And	52497.5773	0.0001	II	R	95
CO And	52490.5572	0.0002	I	R	49
V407 Aql	52530.3494	0.0005	II	R	44
V407 Aql	52591.2226	0.0001	I	R	27
V417 Aql	52448.4567	0.0007	I	R	48
V417 Aql	52489.37578	0.00005	II	R	56
V609 Aql	52496.3482	0.0003	I	R	41
V694 Aql	52507.3796	0.0003	II	R	26
V803 Aql	52496.3704	0.0007	I	R	30
V803 Aql	52504.4045	0.0004	II	R	29
V936 Aql	52504.3780	0.0001	I	R	40
V1075 Aql	52574.24253	0.00008	I	R	50
V1096 Aql	52507.3773	0.0003	I	R	67
HV Aqr	52510.5124	0.0004	II	R	109
SU Boo	52363.5017	0.0001	I	V	188
UW Boo	52362.3983	0.0002	I	V	126
SV Cam	52361.3346	0.0001	I	B	152
XX Cas	52188.63604	0.00007	I	V	191
ZZ Cas	52272.5992	0.0002	II	V	84
CW Cas	52187.5236	0.0003	I	V	96
DN Cas	52587.4405	0.0008	I	R	74
V445 Cas	52448.5471	0.0003	I	V	156
V523 Cas	52156.4927	0.0005	II	V	70
V523 Cas	52159.41335	0.00007	I	V	113
VZ Cep	52277.32429	0.00007	I	V	94
V699 Cep	52188.4091	0.0004	I	V	93
TW CrB	52009.56550	0.00005	I	V	163
TW CrB	52510.4053	0.0003	II	R	55
UW Cyg	52508.5407	0.0008	II	R	78
CG Cyg	52497.3607	0.0002	I	R	123
CG Cyg	52512.51263	0.00008	II	R	117
DK Cyg	52505.38233	0.00005	I	R	65
V401 Cyg	52471.5296	0.0003	II	R	81
V859 Cyg	52505.3375	0.0005	I	R	43
V859 Cyg	52505.5400	0.0008	II	R	28
V865 Cyg	52187.3460	0.0004	I	R	27
Z Dra	52602.68892	0.00003	I	R	94
RX Dra	52509.5179	0.0002	II	R	210
RX Dra	52602.28338	0.00007	I	R	131
EF Dra	52277.6938	0.0007	I	V	122
BD Gem	52187.61686	0.00003	I	R	182
MW Lac	52507.5846	0.0004	I	R	76
Y Leo	52278.67257	0.00003	I	V	175
XX Leo	52362.5005	0.0003	II	R	228
EQ Ori	52267.4332	0.0002	I	R	86
AO Ser	52334.646	0.001	II	V	148
Y Sex	52341.4258	0.0004	II	R	50
EQ Tau	52185.58167	0.00003	II	V	220
GN Vul	52506.328	0.001	I	R	16

Remarks:

Number of observations.

Acknowledgements:

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TIMES OF MINIMUM LIGHT OF NEGLECTED ECLIPSING BINARIES

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We present 59 times of minimum light for 30 mostly neglected eclipsing binaries, as a continuation of an ongoing program of monitoring eccentric orbit, apsidal motion and other type systems. These stars were observed during several seasons and are presented for their long-term value as well as for planning new observations. All data were obtained at Appalachian State University's Dark Sky Observatory. The observations include measurements made with the 32-inch DFM Engineering telescope and Photometrics CH250 CCD camera with a Tek 1024^2 chip and Bessell filter set. Other data were obtained with the 18-inch telescope with a Photometrics CH350 CCD camera and SITe 1024^2 chip and Bessell filter set. Some other data were obtained with an SBIG ST-9E CCD on the 16-inch DFM telescope. These are noted in the table as 32, 18 and 16, respectively. The filters are the Johnson equivalents in the Bessell set, with "C" representing a clear or no filter.

The data were reduced using Mira AP software.† Our times of minimum and their standard errors were calculated using the method of Kwee & van Woerden (1956), using an algorithm by Ghedini (1982).

Acknowledgement:

We are grateful for references provided by Greg Shelton and Brenda Corbin at the U.S. Naval Observatory Library. Other references were obtained at the NASA Astrophysics Data System. This work also made use of the SIMBAD data base and the Space Telescope Science Institute's Digitized Sky Survey. We thank Joe Pollock and Stephen Davis for the development of PMIS macros used in automatic data acquisition, and Lee Hawkins for instrumentation support. We are also grateful for support received from the National Science Foundation, the ASU Research Council, and the Dunham Fund for Astrophysical Research.

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†The Mira AP software is produced by Axiom Research Inc.

Star	Typ	Tel	Filters	HJD-2400000	Error	Remarks
V805 Aql	pri	18	V	51706.7607	0.0006	
BW Boo	pri	18	BVRI	52757.6524	0.0010	
RS CVn	pri	18	V	53133.7233	0.0003	
CV CMa	pri	32	V	53101.5918	0.0010	
CC Cas	sec	18	VR	52957.7847	0.0010	
LX Cas	sec	32	BVR	52985.7128	0.0016	
	pri	32	BVR	53015.7525	0.0014	
V442 Cas	pri	32	V	51028.8266	0.0000	
	pri	32	V	53309.7816	0.0001	
CO Cep	sec	32	C	50068.6345	0.0012	
	pri	32	V	50798.7457	0.0002	
	pri	32	BVR	52933.7265	0.0002	
	sec	32	BVR	52952.5544	0.0009	
TV Cet	pri	18	V	52190.8100	0.0001	
	pri	18	V	52973.6927	0.0002	
DX Cyg	sec	32	R	52841.7995	0.0020	
	sec	32	R	52955.5268	0.0029	
MY Cyg	sec	18	V	53202.6862	0.0001	
	pri	18	V	53224.7032	0.0001	
V456 Cyg	pri	32	V	51377.8757	0.0001	
V490 Cyg	sec	32	V	51487.6184	0.0002	
	sec	32	V	52813.7080	0.0002	
	pri	32	V	52841.6237	0.0002	
V498 Cyg	pri	32	V	53129.8179	0.0012	
V548 Cyg	pri	16	V	53202.8566	0.0001	
V873 Cyg	pri	32	V	50580.8059	0.0012	
	pri	32	V	52894.6914	0.0003	
V886 Cyg	sec	32	VR	53226.7340	0.0027	
	pri	32	V	53319.4955	0.0006	
V974 Cyg	sec	32	V	50584.7872	0.0010	
	pri	32	V	50669.7580	0.0004	
	pri	32	V	50698.5964	0.0014	
	pri	32	BVR	52816.7239	0.0003	
	sec	32	BVR	52933.5942	0.0001	
BF Dra	pri	32	V	52769.7901	0.0001	see footnote††
	pri	32	V	52814.6354	0.0003	
V359 Her	pri	32	VR	53124.7066	0.0002	
	sec	32	V	53225.6627	0.0005	
VW Hya	pri	32	BV	51937.8611	0.0002	
MZ Lac	sec	32	V	50686.6745	0.0006	
	sec	32	V	50705.6304	0.0015	
	pri	32	V	52592.7514	0.0001	
	pri	32	V	53025.5097	0.0002	
V345 Lac	pri	32	C	50081.6444	0.0009	
	sec	32	BVR	51065.6783	0.0044	
	pri	32	V	51302.8060	0.0007	
	sec	32	V	51829.8544	0.0003	
	pri	32	BV	51849.7158	0.0003	
	sec	32	BVR	52848.7564	0.0002	
BM Mon	pri	32	C	50165.6616	0.0001	
	pri	32	V	50480.6330	0.0000	
	sec	32	V	50518.6043	0.0008	
HI Mon	pri	32	V	53081.6396	0.00080	
V451 Oph	pri	18	BVR	52816.7925	0.0002	
	sec	18	V	52914.5486	0.0002	
V1016 Ori	pri	18	R	52239.7937	0.0027	θ^1 Ori A
GG Ori	pri	32	V	50380.8122	0.0002	
ER Sct	pri	16	V	53203.6610	0.0002	
MN Vul	sec	32	V	53200.6587	0.0007	

†† For BF Dra see new ephemeris by Diethelm et al. (1993)

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BVRI OBSERVATIONS OF EM CYGNI IN THE YEARS 2003-2004

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The dwarf nova EM Cyg is an eclipsing and spectroscopic binary that belongs to the Z Cam class (Downes & Shara 1993). From the catalogue of Ritter and Kolb (2003), we know that EM Cyg has V $\simeq 13^{\mathrm{m}}.3$ mag during the regular minimum, V $\simeq 14^{\mathrm{m}}.4$ at minimum during the eclipse, V $\simeq 12^{\mathrm{m}}.5$ during the maximum, and V $\simeq 12^{\mathrm{m}}.9$ in standstill. We observed EM Cyg since 1997 with the aim to study its variability using broad band photometry (Spogli et al. 2003). Here we improve our previous analysis using new BVR_cI_c data obtained during the Summer-Autumn 2003 and 2004, for a total of 57 new nights. All photometric new data are reported in Tables 1 and 2.

The observations of EM Cyg were made at the Perugia Astronomical Observatory with 0.40 m Automatic Imaging Telescope (Tosti et al. 1996), and at Porziano Astronomical Observatory (Assisi) with the 0.35 m Schmidt-Cassegrain telescope equipped with an Hi-SIS 23 CCD camera (Kodak Kaf 401E of 762×512 pixel). The instruments used and the photometric techniques have been already described in Spogli et al. (1998). Both telescopes are endowed with standard BVR_cI_c Johnson-Cousins broad-band filters. An inter-comparison between results obtained during the same nights shows no relevant systematic difference, within the typical standard deviation of each instrument. All data are obtained in differential photometry using the calibration stars reported by Misselt (1996) and Spogli et al. (2003).

Figure 1 shows the V light curve during 2003, and the visual estimates available from AFOEV (`http://cdsweb.u-strasbg.fr/afoev/`). A similar comparison can be done with all our database (including Spogli et al. 2003), with the conclusion that our multi-band photometry samples very well the outburst, the decline and the minimum phases, while there are few data about the rising phase. The typical time interval between two outbursts is 23 days, with a range of 15-40 days. The general trend is well characterized, with the emission dominated by the secondary star during the minimum ($V-I \simeq 1^{\mathrm{m}}.1$, see Figure 2) and by the accretion disk during the outburst ($V-I \simeq 0^{\mathrm{m}}.6$). The main photometric informations are summarized in Table 3, taking into account the new data and the 1997-2000 data (Spogli et al. 2003).

Table 1 2003 BVR$_c$I$_c$ data of EM Cyg

UT Date	JD (2450000+)	B	V	R_c	I_c
02/06/2003	2792.528	13.02±0.05	12.82±0.04	12.49±0.04	12.01±0.04
05/06/2003	2795.549	13.29±0.13	12.97±0.05	12.65±0.04	12.14±0.03
06/06/2003	2796.556	13.61±0.12	13.21±0.05	12.79±0.04	12.21±0.03
11/06/2003	2801.581	14.08±0.05	13.38±0.05	12.93±0.04	12.33±0.03
12/06/2003	2802.574	13.96±0.05	13.43±0.05	13.02±0.04	12.37±0.03
20/06/2003	2810.554	13.11±0.05	12.86±0.05	12.58±0.04	12.14±0.03
21/06/2003	2811.546	13.38±0.07	13.01±0.05	12.65±0.04	12.12±0.03
22/06/2003	2812.558	13.57±0.08	13.15±0.04	12.74±0.04	
25/06/2003	2815.542	14.31±0.07	13.64±0.04	13.08±0.04	12.46±0.04
26/06/2003	2816.592	14.43±0.08	13.57±0.05	13.04±0.03	
08/07/2003	2828.501	12.78±0.09	12.43±0.04	12.13±0.04	11.66±0.04
12/07/2003	2832.521	13.35±0.07	13.12±0.05	12.77±0.04	12.22±0.04
15/07/2003	2836.496	14.51±0.05	13.61±0.04	13.09±0.04	12.47±0.04
18/07/2003	2839.475	14.49±0.10	13.62±0.05	13.13±0.04	12.46±0.04
19/07/2003	2840.495	13.99±0.11	13.53±0.04	13.04±0.04	12.41±0.04
22/07/2003	2842.536	14.01±0.09	13.42±0.06	13.12±0.03	12.48±0.04
23/07/2003	2843.526	14.47±0.11	13.53±0.03	13.04±0.04	
03/08/2003	2854.509	13.44±0.06	12.88±0.05	12.54±0.04	12.07±0.04
05/08/2003	2857.334			12.86±0.05	
06/08/2003	2858.428	14.33±0.05			
10/08/2003	2862.461	14.12±0.11			
12/08/2003	2864.487	14.23±0.07	13.49±0.04	13.15±0.04	12.47±0.04
13/08/2003	2865.404		13.68±0.05	13.18±0.04	12.54±0.04
18/08/2003	2870.321		13.57±0.05	13.08±0.05	
19/08/2003	2871.441	14.03±0.05	13.51±0.04	13.01±0.04	
20/08/2003	2872.392	14.32±0.12	13.83±0.04	13.21±0.05	
22/08/2003	2874.394	14.09±0.08	13.51±0.04	13.02±0.05	12.43±0.04
10/09/2003	2893.389	12.25±0.12			
15/09/2003	2898.346	12.51±0.09	12.32±0.05		
17/09/2003	2900.405	12.85±0.05	12.53±0.03	12.25±0.04	11.81±0.04
18/09/2003	2901.368	12.94±0.07	12.68±0.05	12.35±0.05	11.92±0.04
19/09/2003	2902.377	13.23±0.09	12.84±0.05	12.54±0.05	12.12±0.04
21/09/2003	2904.317	13.71±0.06	13.20±0.08	12.86±0.05	12.35±0.04
22/09/2003	2905.341	14.01±0.05	13.31±0.04		
25/09/2003	2908.355	13.98±0.05	13.28±0.07	12.85±0.07	12.37±0.05
26/09/2003	2909.363	13.96±0.07	13.41±0.06	12.92±0.06	12.34±0.05
03/10/2003	2916.336	13.26±0.08	12.76±0.05	12.44±0.05	12.03±0.04
06/10/2003	2919.321	13.67±0.08	13.21±0.05	12.72±0.05	
10/10/2003	2923.331	14.04±0.08	13.44±0.05	12.98±0.05	12.43±0.04
12/10/2003	2925.307	13.91±0.04	13.39±0.05		
16/10/2003	2929.396	13.23±0.12	12.86±0.05	12.51±0.05	12.09±0.04
27/10/2003	2940.271	13.56±0.13	13.07±0.05	12.76±0.03	12.21±0.04

Table 2 2004 BVR_cI_c data of EM Cyg

UT Date	JD (2450000+)	B	V	R_c	I_c
25/05/2004	3150.599	13.08±0.09	12.74±0.05	12.45±0.04	12.01±0.03
31/05/2004	3156.609	13.69±0.08	13.31±0.05	12.91±0.05	12.37±0.04
12/06/2004	3168.612	13.82±0.08			
19/06/2004	3175.557	13.75±0.08	13.24±0.04	12.84±0.04	
06/07/2004	3193.394		12.67±0.07		11.94±0.06
15/07/2004	3202.384		13.40±0.05		12.33±0.04
16/07/2004	3203.379		13.31±0.05		12.37±0.05
17/07/2004	3204.379		13.49±0.05		12.36±0.05
22/07/2004	3209.487	14.04±0.09			
23/07/2004	3210.395		13.45±0.05		12.34±0.04
30/07/2004	3217.413		13.45±0.05		12.31±0.04
01/08/2004	3219.498	14.09±0.07			
17/08/2004	3235.441	14.45±0.11	13.58±0.05	13.05±0.05	12.42±0.04
18/08/2004	3235.514	14.38±0.09	13.62±0.05	13.10±0.04	12.50±0.04
21/08/2004	3239.444	13.89±0.12	13.19±0.07	12.74±0.04	12.22±0.05
22/08/2004	3239.571	13.93±0.09	13.26±0.04	12.78±0.04	12.24±0.05
08/10/2004	3287.418		12.91±0.05		12.16±0.05
23/10/2004	3302.404		13.57±0.05		12.35±0.04

Table 3 Photometric characteristics of EM Cyg from our 1997-2004 observations.

	B	V	R_c	I_c
Maximum Outburst	12.25	12.20	11.98	11.62
Minimum of Light	14.51	13.83	13.24	12.65
Outburst Amplitude	2.2	1.5	1.1	0.9
Decay Rates(mag/day)	0.18±0.06	0.14±0.04	0.12±0.04	0.09±0.04
	$(B-V)$	$(V-R_c)$	$(V-I_c)$	
Averages during the outburst	0.2	0.3	0.7	
Averages during quiescence	0.7	0.5	1.1	

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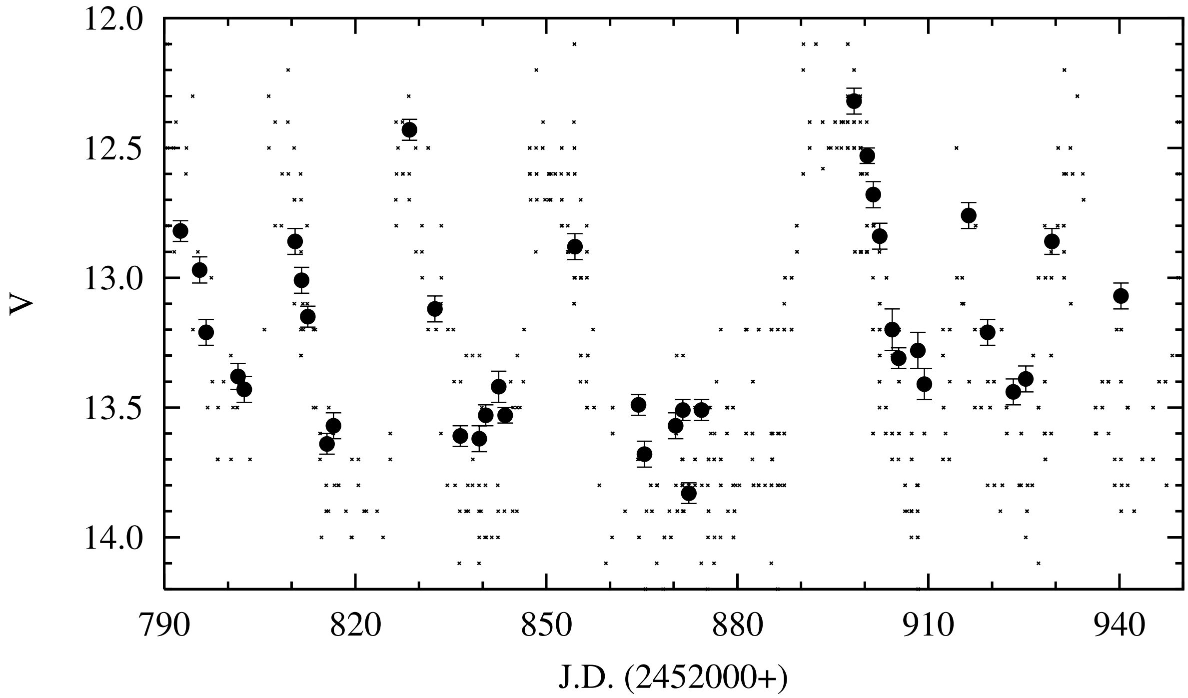

Figure 1. *V* light curve of EM Cyg from June 1st to October 27th 2003. Circles represent the data here reported, while small crosses are visual estimates available from AFOEV (`http://cdsweb.u-strasbg.fr/afoev/`).

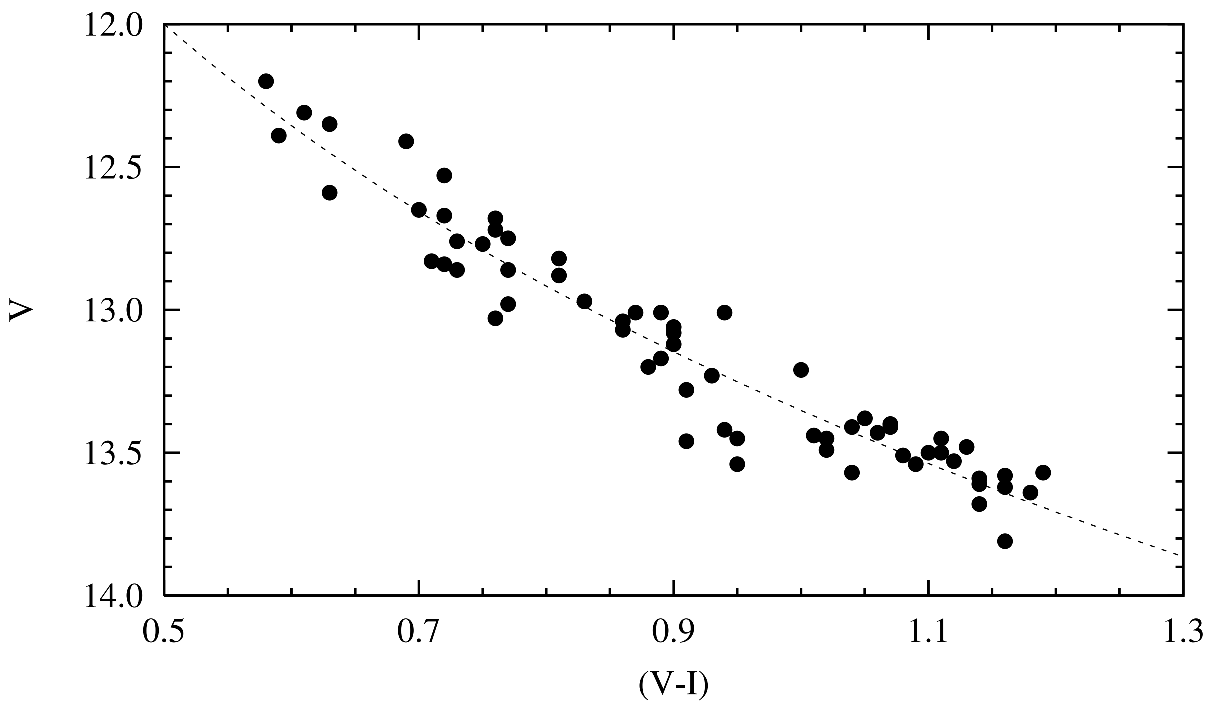

Figure 2. Color-Magnitude diagram for the dwarf nova EM Cygni. The diagram contains the data here reported and the previous results (Spogli et al. 2003).

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THE 2003 EXTENDED LOW STATE OF LQ Peg

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Cataclysmic Variables (CVs) are semi-detached binary systems, consisting of a white dwarf primary star accreting from its lower main sequence, Roche-lobe filling companion. The gravitational potential energy of the accreted material is converted into radiation, much of which is emitted in the optical. Most of the long-time-scale variability is thought to be due to changes in the mass accretion rate ($\dot{M}$). LQ Peg (also known as PG2133+115 or Peg 6) is a poorly-studied CV, with a suggested orbital period of $2^{\rm h}\!\!.9$ (Ringwald 1993; however see Misselt & Shafter 1995). It is classified as a thick-disk, UX UMa system (Ferguson, Green & Liebert 1984) and has been reported to have occasional low-amplitude ($\sim$0.25 mag) outbursts and dips (Honeycutt & Kafka 2004; hereafter HK04). It is a member of the VY Scl subclass of CVs, containing systems with large (up to 5 mag) drops in their optical light curves, presumably due to disruptions of the mass transfer.

A low state of LQ Peg was first recorded photographically in 1969 (Sokolov et al. 1996) and the second one was noted in 1999 (Kato & Uemura 1999). Schmidtke et al. (2002) reported that considerable flickering was present during recovery from the 1999 fading, but no coherent orbital modulation was found. The rise from the 1999 low-state was also recorded by RoboScope, a 16-inch automatic telescope located in central Indiana (Honeycutt & Turner 1992). HK04 included the 1999 low state in a study of the transitions of 8 disk VY Scl systems, in which the shapes of the transitions to and from the low state were argued to be consistent with being due to disruption of $\dot{M}$ as the umbra and penumbra portions of starspots on the secondary star migrate underneath the L1 point (Livio & Pringle 1994). The last datum of the RoboScope light curve presented in that study was taken in 2003 July, where the system appeared to have faded towards a new low state. We present here the new (2003) low state of LQ Peg, in which the system seems to have dropped to its faintest observed brightness. This current study complements the HK04 paper, which will help understand the long-term behavior of the system and perhaps put constraints on the cause of the low states.

About 11 years of RoboScope photometry of LQ Peg have accumulated since 1993-July; a description of the data acquisition/reduction of the RoboScope photometry can be found in HK04. The 1993-July to 2004-June light curve is shown in Fig. 1, where we have numbered the 1999 and 2003 low states as 2 and 3 respectively (the Sokolov et al. low state of 1969 (not shown) being number 1). Unfortunately, only the recover from the low-state was observed for each of these three events, due to yearly gaps in the coverage.

Fig. 2 shows the two RoboScope low states. A 1-magnitude displacement on the vertical axis facilitates the distinction between low state 2 and 3 which are drawn with

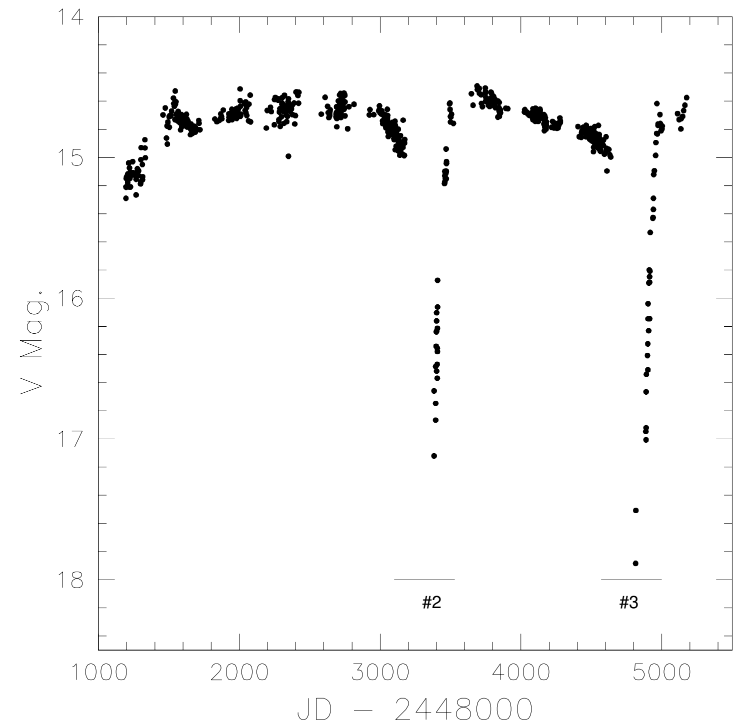

Figure 1. 1993-2004 V-band light curve of LQ Peg

Table 1: LQ Peg low states

Low State	Duration(d)	Amplitude(mag)	τ_{fall}(d)	τ_{rise}(d)
1	<1500:	3.2:	-	50:
2	<250:	<2.6	<100	52
3	<250:	3.3:	< 65	52

triangles and crosses respectively. Table 1 displays the low state characteristics as recorded by RoboScope. For completeness, we also include the low state of 1969, as presented in Sokolov et al. (1996). We would like to caution the reader about the entries for the 1969 low state, since they are estimates from the B light curve of Fig. 1 in Sokolov et al. (1996). Since neither of the declines to the low states was recorded we take the last high-state data point for the beginning, to determine the upper limit of the duration of the low state. The speed of each rise is characterized by the e-folding time (τ), defined as:

$$\tau = \frac{(log_{(10)}e/0.4)}{(\Delta m/\Delta t)} = \frac{1.086}{(\Delta m/\Delta t)} \quad (1)$$

Because of the data gaps many of the parameters are only limits. Nevertheless, there are remarkable similarities, including a very slow ~0.3 mag decline in the year preceding the low state, and a recovery to a level ~0.4 mag brighter than before the low state. The shapes of the recoveries for low states 2 and 3 are similar, being steeper when fainter (see HK04), and the overall speeds of the rises are the same within the errors, at τ~50 days.

VY Scl low states are often described to be random. There is undeniably a significant stochastic component to the spacings and depths of VY Scl low states, as well as a

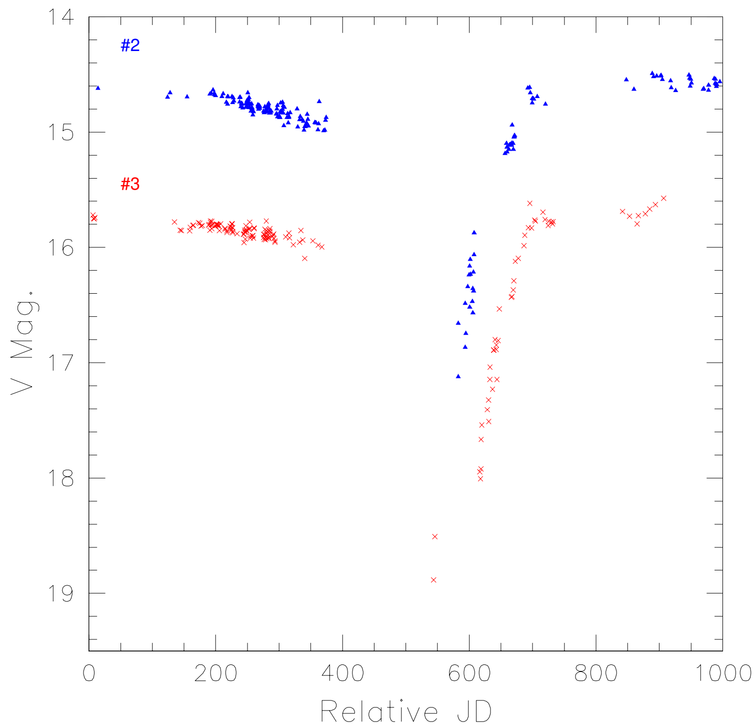

Figure 2. Low states 2 and 3, aligned on the JD axis to show the similarities. The light curve for low state 3 has been offset 1 mag for clarity

distribution to the shapes and speeds of the transitions, which nevertheless seems to peak around 20-30 days. On the other hand, individual systems often show a clear preference for certain transition speeds and for pairs (or series) of low states with nearly identical parameters. V794 Aql is one of the best examples of such behavior (Honeycutt & Robertson 1998; HK04), and it appears that LQ Peg is another. In HK04, the transitions to and from the low states in VY Scl systems were interpreted as being due to the umbra/penumbra portion of starspots on the secondary star drifting underneath the L1 point, consistent with the Livio & Pringle (1994) scenario. Outside the low states, the characteristic light curve modulation of $\sim$0.5 mag in amplitude can be interpreted as being due to starspot cycles on the secondary star (as described in Warner 1988 among others) which modulate mass transfer.

The time between successive low states in LQ Peg does not appear to be constant. Although there are only three recorded low states, from the RoboScope long term light curve we can infer that the time interval between low states 1 and 2 is greater than 6 years whereas between low states 2 and 3, only 3 years lapsed. It will be interesting to see if there is a consistent, cyclic-like behavior of the occurrence of low states in such systems, but another decade of continuous monitoring is essential for this. On the other hand, the $\sim$0.4 mag drop of the systems's brightness preceding low states 2 and 3 may be a characteristic of all the low states of the system and may help predict the occurrence of future low states.

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ON A SHORT-PERIODIC PULSATING COMPONENT IN THE ALGOL-TYPE ECLIPSING BINARY SYSTEM VV UMa

KIM, S.-L.[1]; LEE, J. W.[2]; LEE, C.-U.[1]; KANG, Y. B.[1]; KOO, J.-R.[1]; MKRTICHIAN, D. E.[3,4]

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[2] Dept. of Astronomy and Space Science, Chungbuk National University, Cheongju, 361-763, Korea

[3] ARCSEC, Sejong University, Seoul, 143-747, Korea

[4] Astronomical Observatory, Odessa National University, Shevchenko Park, Odessa, 65014, Ukraine

Name of the object:
VV UMa

Observatory and telescope:
Mt. Lemmon Optical Astronomy Observatory in USA, 1.0m telescope[1]

Detector:	a) 1K CCD camera and b) 2K CCD camera

Filter(s):	Johnson B, exp. time $\sim$ 30 sec

Date(s) of the observation(s):
a) March 24, 2003; b) November 27, 2004; November 29, 2004; December 26, 2004

Comparison star(s):	GSC 03810-01503

Check star(s):	GSC 03810-00988

Transformed to a standard system:	No

Availability of the data:
Upon request

Method of data reduction:
Standard CCD-frame reduction using the IRAF/DAOPHOT[2] package. Aperture photometry was applied to get instrumental magnitudes with an aperture radius of 10 pixels (=$6''.4$); seeing size was about $2''.9$ during the observing runs.

[1]Korea Astronomy & Space science Institute (*KASI*) had installed the telescope and has been operating it by remote control from Korea via a network connection.

[2]IRAF is distributed by the National Optical Astronomy Observatories, which are operated by the Association of Universities for Research in Astronomy, Inc., under cooperative agreement with the National Science Foundation.

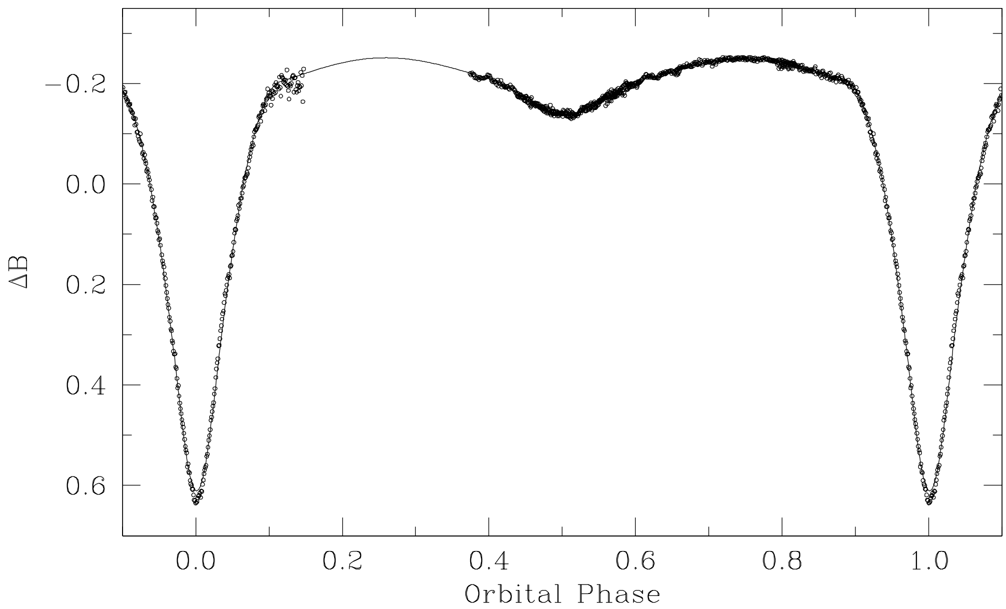

Figure 1. Phase diagram of VV UMa in B-passband. Open circles are the data obtained in the 2003-2004 observing runs. The line is a synthetic eclipsing light curve which was derived from the 1998-version of Wilson & Devinney (1971) code, taking into consideration the light curve solution by Lázaro et al. (2002).

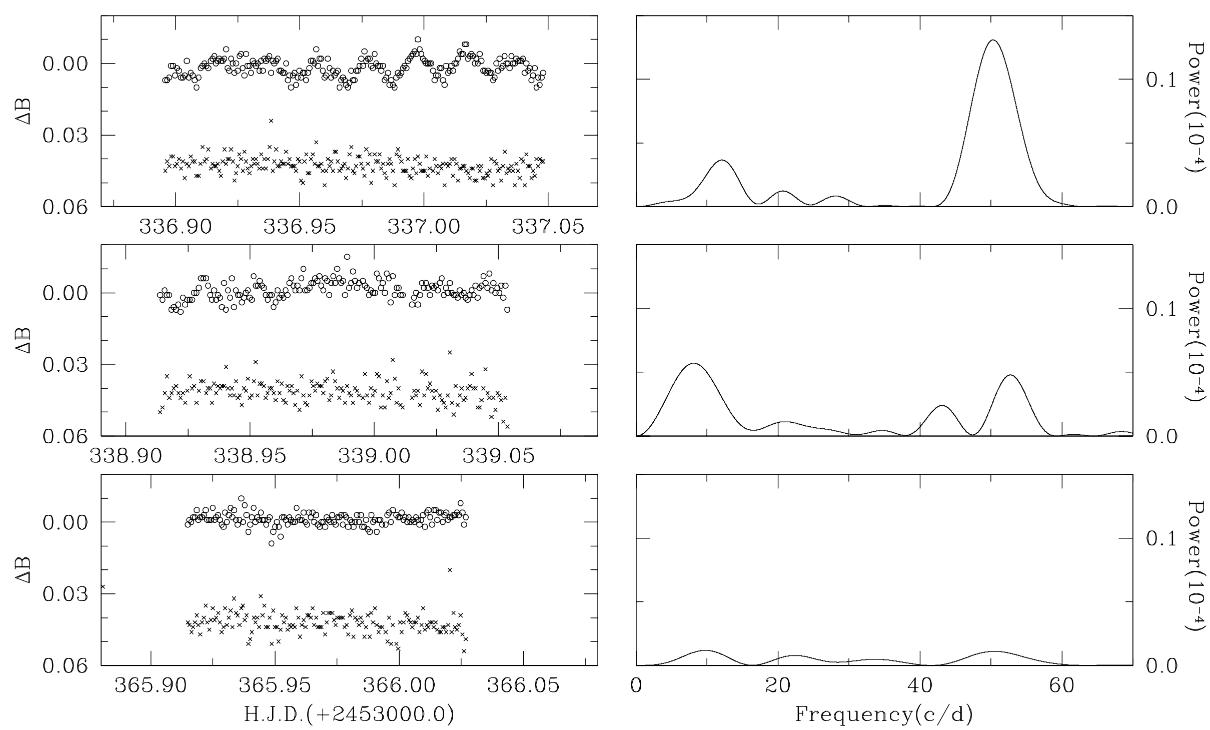

Figure 2. Light variations of the residuals after subtracting the synthetic curve from the data (left) and their power spectra (right) for each night, except for the data around the primary eclipsing phase. The residuals are represented by open circles. Note that the power at a high frequency around 50 cycles per day (c/d) varies greatly from night to night. Differential magnitudes of a check star are also displayed in arbitrary scale for comparison (crosses in left panels).

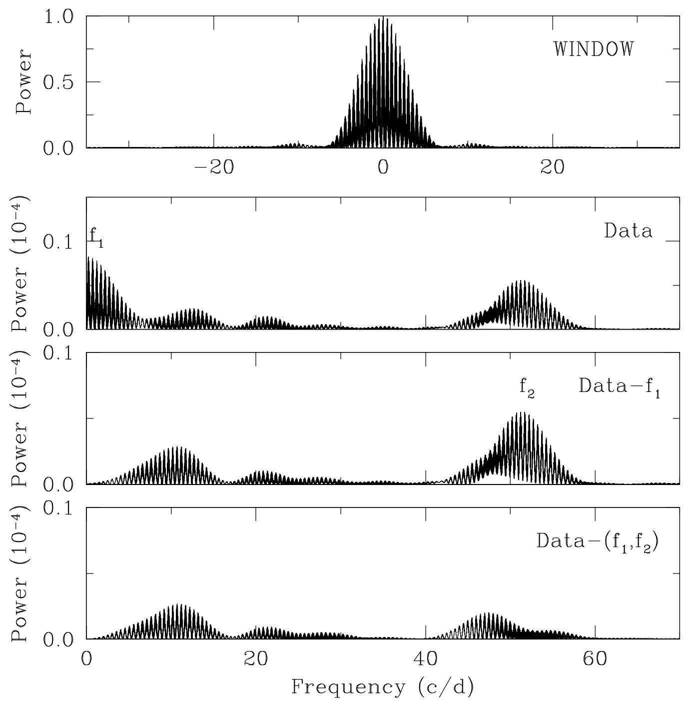

Figure 3. Power spectra of the residuals (combined), except for the data around the primary eclipsing phase. The window spectrum is displayed in the top panel. We can detect a peak of $f_2 = 51.239$ c/d in the third panel. f_1 and peaks at frequencies less than 15.0 c/d may be originated from the incomplete fit of the synthetic curve.

Remarks:

As a part of our photometric survey project to search for A-type pulsating components in eclipsing binary systems (Kim et al. 2003), we monitored the semi-detached Algol-type eclipsing binary VV UMa. Our observations showed undoubtedly a short-period small-amplitude pulsation of VV UMa, which had been reported firstly by Lázaro et al. (2001, 2002).

Phase diagram of VV UMa is shown in Figure 1, where orbital phases were calculated with the orbital period of 0.6873801 day and the primary minimum epoch of *H.J.D.*2452500.0528 (Kreiner 2004). We obtained residuals after subtracting a synthetic eclipsing light curve from the data. Figure 2 displays the residuals and their power spectra for each night. We can detect sinusoidal light variations with a short period of about 0.02 day and maximum amplitude of about $0\overset{m}{.}015$, see the top left panel, where the power spectrum shows a definite peak at 50.3 cycles per day (c/d). Amplitudes of the variations vary from cycle to cycle, consequently the power at the frequency around 50 c/d changes greatly from night to night, implying that the variable star may have multiple periods.

Power spectra of the combined residuals show a peak at high-frequency of $f_2 =$ 51.239 c/d (=0.0195 day), see Figure 3. If we accept that the variable star has multiple periods, another peak at high-frequency of 47.460 c/d (=0.0211 day) at the bottom panel in Figure 3 is reliable; this is the same as the dominant period detected by Lázaro et al. (2001, 2002).

Remarks:
Considering the δ Scuti-type pulsation characteristics (multiple periods and small-amplitude), spectral type of A1.5-2V (Lázaro et al. 2002) for the primary component, and the semi-detached binary configuration, we suggest that VV UMa is also the member of the oscillating EA (oEA) stars, a group of mass-accreting pulsating components in Algol-type semi-detached eclipsing binary systems (Mkrtichian et al. 2004). Then the number of the oEA stars has increased to sixteen (see Table 1 in Mkrtichian et al. 2005).

Acknowledgements:
This research made use of the SIMBAD database, operated at CDS, Strasbourg, France

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OBSERVATIONS OF VARIABLES

The last but one issue of the volume publishes new observations, and results on known variable stars. Figures and data files are available electronically.

The Editors

Date: 2 February 2004
Reported by: Bedient, J. - University of Hawaii, bedient@hawaii.edu Richwine, P. - University of Arizona, pebbler@email.arizona.edu

Name of the object:
NSV 12374
Remarks:
NSV 12374 is found to be a Mira-type variable star using archived CCD images and ASAS-3 data. The period is 265 days and range 13.0 – <15 (V). Cross-identifications made: NSV 12374 = SV* R 321 = IRAS 19429-0526 = USNO-B1.0 0846-0566062 = 2MASS J19453923-0519183

Date: 12 February 2004
Reported by: Ignatieva, T.I. - Sternberg Astronomical Institute, Moscow, Russia Antipin, S.V. - Sternberg Inst. and Instr. of Astr., RAS, Moscow, Russia, antipin@sai.msu.ru

Name of the object:
V1543 Cyg
Remarks:
V1543 Cyg, an SR: star in the GCVS, is actually a classical Cepheid. JDmax = 2443343.07 + 2.03029d × E.

Date: 2 April 2004
Reported by: Dumitrescu, A. - Astronomical Institute of the Romanian Academy, alex@aira.astro.ro Iliev, L. - Astronomical Institute of the Bulgarian Academy, liliev@astro.bas.bg Tudose, V. - Astronomical Institute of the Romanian Academy, vtudose@aira.astro.ro

Name of the object:
V376 And = HIP 12039 = HD 15922
Remarks:
We report BV observations of the eclipsing binary system V376 And. Six times of minima are presented.

Date: 16 April 2004
Reported by: Otero, S. - Grupo Wezen 1 88 & CEA, Argentina, varsao@fullzero.com.ar Pojmanski, G. - ASAS, `http://www.astrouw.edu.pl/~gp/asas`

Name of the object:
NSV 12236 = ASAS 193907-2049.2 = GSC 6311 1034 = SV* BV 1713 = 2MASS J19390656-2049140
Remarks:
NSV 12236 is a CWA star with the following elements: HJDmax 2452001.10 + 14.279 × E. Range in V= 11.35 – 12.55 according to ASAS-3 data.

Name of the object:
NSV 05356 = ASAS 114920-6600.6 = HD 310803 = SV* BV 726 = CPD −65 01725 = CoD −65 01151 = GSC 8985 2113 = 2MASS J11491992-6600387
Remarks:
SIMBAD cross-identifications are correct but the position given is wrong due to a typographic error in the DEC that was written as −06 degrees instead of −66. Tycho-2 position is $11^h49^m19\overset{s}{.}944$ $-66°00'38\overset{''}{.}65$ (2000.0) SIMBAD wrongly puts the star at $11^h49^m42^s$$-06°00\overset{'}{.}6$ (2000.0) NSV 05356 is a short period DCEP star (HD spectrum G0) with the following elements: HJDmax 2452056.529 + 1.39143 × E. Range in V= 9.89 – 10.33 according to ASAS-3 data.

Name of the object:
NSV 10164 = ASAS 180601-4731.5 = GSC GSC 8361 1107 = CPD −47 8688 = CD −47 12046 = SV* BV 1217 = 2MASS J18060173-4731272
Remarks:
RVA variable star with elements: HJDmax 2452057.0 + 108.71 × E. V range is 9.84 – 12.76 (ASAS-3 data).

Date: 27 April 2004

Reported by:
Bernhard, K. - Linz, Austria, kl.bernhard@aon.at Kiyota, S. - Tsukuba, Japan, skiyota@nias.affrc.go.jp Moschner, W. - Lennestadt, Germany, wolfgang.moschner@t-online.de

Name of the object:
GSC 0752.0542 = Brh V39
Remarks:
GSC 0752.0542 (RA: $07^h01^m00\overset{s}{.}4$ $+10°03'46''$, J2000) can be called as an anomalous RRab star, because of a period, which is typical for an RRab star and a folded light curve with a rather low amplitude, which looks more like an RRc star. This star shows a clear light curve variation, but a period analysis of the available data does not point to any consistent solution. Max = HJD 2452306.468 + 0.71240 × E .

Date: 24 June 2004

Reported by:
Krajci, Tom - 3933 Stockton Loop, SE Albuquerque, NM 87118-1104, loukrajci@comcast.net

Name of the object:
V718 Her
Remarks:
V718 Her is currently listed in the GCVS as type EW/KW. Recent unfiltered observations from Tashkent show that it is in fact type RRc. Initial data indicate the following ephemeris for time of maximum: HJDmax = 2453163.6535(8) + 0.297626(5) × E . Note that the period is significantly different from the GCVS value of 0.4588788, which is assessed as an aliasing effect.

Name of the object:
BH UMa
Remarks:
BH UMa is currently listed in the GCVS as type EW/KE. Recent unfiltered observations from Tashkent show that the star is in fact type RRc. Initial data indicate the following ephemeris for time of maximum: HJDmax = 2453053.6545(5) + 0.349350(3) × E .

Date: 4 August 2004

Reported by:
Sahin, T. - Akdeniz University, Turkey Yesilyaprak, C. - Akdeniz University, Turkey

Name of the object:
V2129 Cyg
Remarks:
V2129 Cyg was discovered by the Hipparcos Satellite as a low amplitude delta Scuti type star. Modulation of the light curve is suspected.

Date: 1 September 2004

Reported by:
Frank, P.- BAV, Germany, frank.velden@t-online.de Bernhard, K.- BAV, Austria, kl.bernhard@aon.at Quester, W.- BAV, Germany, wquester@aol.com Lloyd, C. - Rutherford Appleton Laboratory, UK, cl@astro1.bnsc.rl.ac.uk

Name of the object:
GSC 1927-0862 = Brh V130
Remarks:
GSC 1927-0862 (RA: $08^h08^m15\overset{s}{.}9$ DEC: $+23°04'10''$, J2000) is a W UMa star with the ephemeris: HJDminI = 2452707.522 + 0.536435 × E, range (unfiltered, near V): 12.7 – 13.1

Name of the object:
GSC 4992-0663 = Brh V134
Remarks:
GSC 4992.0663 (RA: $14^h36^m28\overset{s}{.}4$ DEC: $-05°36'22''$, J2000) is a W UMa star with the ephemeris: HJDminI = 2452811.400 + 0.242075 × E, range (unfiltered, near V): 12.6 – 13.1

Name of the object:
GSC 5749-1622 = Brh V137
Remarks:
Though W UMa stars often can be identified with an X-ray source, an entry in the ROSAT All-Sky Bright Source Catalogue (1RXS) is quite rare. GSC 5749-1622 (RA: $20^h19^m49\overset{s}{.}6$ DEC: $-12°30'38''$, J2000) can be identified with 1RXS J201950.0-123037, the Tycho-2 Spectral Type Catalog gives the spectral type F8/G0 V, corresponding to an effective temperature of 6200 K. Ephemeris: HJDminI = 2452909.387 + 0.418895 × E, range (unfiltered, near V): 9.7 – 10.3 .

Date: 2 September 2004

Reported by:
Złoczewski, K. - Warsaw University Astronomical Observatory, kzlocz@astrouw.edu.pl

Name of the object:
TU Tri
Remarks:
An outburst (14.6 mag) was reported by M. Simonsen on January 1 2003. The last reported possible outburst was in 1998, further two outbursts were recorded in 1995. K. Torii confirmed that it was still in outburst on January 4 2003, and the resultant light curve showed no superhumps (vsnet-campaign-dn 3237, 3262). Our light curve on January 1/2 2003 shows clear superhumps with period 0.0745d estimated from the two observed minima. VAR−COMP denotes the difference of the magnitude of the variable and the magnitude corresponding to the sum of intensities of the comparisons. A small variation is found between C1 and C2 (up to 0.05 mag., see fig. 5599-f19), however, this does not affect the result we found on TU Tri.

Date: 3 November 2004
Reported by: Baranov, A. - Moscow Astronomy Club (c/o Sternberg Astron. Inst.)

Name of the object:
KP Dra
Remarks:
Min(I)=JD2448122.49+2.012415 × E. Bpg=12.8 – 16.0.

Date: 9 November 2004
Reported by: Bernhard, K.- BAV, Austria, klaus.bernhard@liwest.at Frank, P.- BAV, Germany, frank.velden@t-online.de Moschner, W. - BAV, Germany, wolfgang.moschner@t-online.de Proksch, W. - BAV, Germany, willi.proksch@t-online.de

Name of the object:
GSC 2144.1499 = Brh V152
Remarks:
GSC 2144.1499 (RA: $19^h55^m11^s.6$ DEC: $+24°57'10''$, J2000) is a WUMa star with the ephemeris: HJDminI = 2453284.307 + 0.36424 × E, range (unfiltered, near V): 13.1 – 13.6

Name of the object:
GSC 1830.1432 = Brh V129
Remarks:
GSC 1830.1432 (RA: $04^h43^m41^s.3$ DEC: $+22°53'38''$, J2000) is a WUMa star with the ephemeris: HJDminI = 2452928.5399 + 0.271825 × E, range (unfiltered, near V): 11.5 – 11.8

Name of the object:
GSC 1419.0091 = Brh V132
Remarks:
GSC 1419.0091 (RA: $10^h11^m59^s.2$ DEC: $+16°52'30''$, J2000) is a WUMa star with the ephemeris: HJDminI = 2452754.4602 + 0.266727 × E, range (unfiltered, near V): 11.4 – 11.7

Date: 9 November 2004

Reported by:

Pejcha, Ondrej - Nicholas Copernicus Observatory and Planetarium, Brno, Czech Republic, pejcha@astro.sci.muni.cz
Mikulasek, Zdenek - Institute of Theoretical Physics and Astrophysics, Masaryk University in Brno, Kotlarska 2, 611 37 Brno, Czech Republic
Hroch, Filip - Institute of Theoretical Physics and Astrophysics, Masaryk University in Brno, Kotlarska 2, 611 37 Brno, Czech Republic

Name of the object:

TrES-1 = GSC 02652-01324

Remarks:

Using a simple model of exoplanet transit and a new robust method for O−C determination (both will be elaborated thoroughly elsewhere - Mikulasek et al., 2005) we have derived mid-transit timings for TrES-1 exoplanet transits on two dates. Namely, JD_{hel} = 2 453 253.4685(6) (open circles) JD_{hel} = 2 453 256.4985(18) (V - dots, Rc - open squares) The O−C with respect to Alonso et al. (2004) ephemeris are (0.0012 ± 0.0007) and (0.0010 ± 0.0018), respectively.

Date: 10 November 2004

Reported by:

Khruslov, A.V., Tula, Russia, khruslov@bk.ru
SkyDOT team - http://skydot.lanl.gov
Pojmanski, G., - ASAS, `http://www.astrouw.edu.pl/~gp/asas`

Name of the object:

V523 Aur = GSC 2965-00210 = NSVS 4705573 = Mis V0002

Remarks:

V523 Aur , an E: star in the GCVS, is a W UMa star with the elements: JDminI = 2451518.32 + 0.33043 d × E , range 13.4 – 14.2(R) according to ROTSE1 data.

Name of the object:

FT Boo = GSC 3465-00188 = NSVS 5115340 = Tmz V042

Remarks:

FT Boo is currently listed in the GCVS as type L:. According to ROTSE1 data, it is an RRAB star with the following elements: JDmax = 2451422.190 + 0.458775 d × E, range 13.4 – 14.6 (R), M–m 0.15 P

Name of the object:

FU Boo = GSC 1472.01141 = NSVS 10517999 = ASAS 142254+1932.2 = Tmz V734

Remarks:

FU Boo , an LB: star in the GCVS, is an RRAB star with the elements: JDmax = 2451432.74 + 0.65357 d × E , range 13.6 – 14.6 (R), 13.2 – 14.6 (V), M–m 0.18 P according to ROTSE1 and ASAS-3 data.

Name of the object:
CF Cam = GSC 3728.01092 = NSVS 1965946 = IRAS 03314+5804

Remarks:
CF Cam , a DCEP: star in the GCVS, is a classical Cepheid with the elements: JDmax = 2451366.0 + 9.44 d *times* E, range 11.2 – 11.7 (R) according to ROTSE1 data.

Name of the object:
GW Cnc = GSC 1399.01081 = NSVS 10127789 =ASAS 084813+2107.2 = Tmz V003

Remarks:
GW Cnc , an L: star in the GCVS , is actually an EW star with the elements: JDminI =2451554.023 + 0.281415 d × E, range in 12.6 – 13.2 – 13.1 (R), 12.3 – 13.2 – 13.2 (V) according to ROTSE1 and ASAS-3 data.

Name of the object:
V602 Cyg = TYC 3190.00950 = NSVS 5904647

Remarks:
V602 Cyg is an L: star (spectral type G7) in the GCVS. According to NSVS data, it is an SRD star with the elements: JDmax = 2451260. + 34.5 d × E, range 10.3 – 10.6 (R).

Name of the object:
DR Lyn = GSC 3421.02216 = NSVS 4785816 = Tmz V023

Remarks:
DR Lyn is an EA star in the GCVS without light elements. Light elements are: JDminI = 2451483.98 + 1.78080 d × E , range 12.4 – 14.5 – 12.6 (R), D = 0.17 P according to ROTSE1 data.

Name of the object:
V344 Ser = GSC 0347.00695 = NSVS 13419554 = ASAS 151159+0602.3 = Tmz V044

Remarks:
V344 Ser , an L star in the GCVS , is actually an RRAB star with the elements: JDmax = 24 51416.837 + 0.46506 d × E , range 13.1 – 14.3 (R), 12.7 – 14.5 (V), M–m 0.1 P according to ROTSE1 and ASAS-3 data.

Name of the object:
KQ UMa = GSC 4376.01629 = NSVS 782942 = Tmz V083

Remarks:
KQ UMa is an L: star in the GCVS. The star actually belongs to the RRAB type with the following elements: JDmax = 2451493.21 + 0.48635 d × E, range 14.0 – 15.2 (R), M–m 0.1 P according to ROTSE1 data.

Name of the object:
OQ Vir = GSC 0306.00750 = NSVS 13266152 = ASAS 132543+0603.4 = Tmz V747

Remarks:
OQ Vir , an SR: star in the GCVS, is actually an RRAB star with the elements: JDmax = 2451475.75 + 0.603915 d × E, range 13.6 – 14.7 (R), 13.1 – 14.5 (V), M–m 0.2 P according to ROTSE1 and ASAS-3 data.

Date: 22 November 2004
Reported by:
Hoogeveen, G.J. - Bottelaarpassage 43, Almere 1315 EP, Netherlands, gertho@xs4all.nl

Name of the object:
VX Dra
Remarks:
We argue that VX Dra is identical to FU Dra, despite considerable difference in coordinates.

Date: 27 January 2005
Reported by:
Németh, P. - University of Szeged, Hungary, pnemeth@titan.physx.u-szeged.hu Kiss, L.L. - University of Sydney 2006, NSW Australia Sárneczky, K. - University of Szeged, Hungary

Name of the object:
HS 0705+6700 = GSC 4123-265
Remarks:
New observations in Johnson V and Cousins I bands are presented for the pre-cataclysmic binary HS 0705+6700. The new ephemeris, improved by seven new epochs of minimum, is HJD(min)=2453071.42845 + 0.095646783(8)E.

References:

Alonso, R., Brown, T.M., Torres, G., Latham, D.W., Sozzetti, A., Mandushev, G., Belmonte, J.A., Charbonneau, D., Deeg, H.J., Dunham, E.W., O'Donovan, F.T., Stefanik, R.P., 2004, *ApJL*, **613**, L153

Mikulasek, Z., et al., 2005, in preparation

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REPORTS ON NEW DISCOVERIES

The last issue of the volume publishes a list of newly discovered variables. Figures (finding charts and light curves) and data files are available electronically.

Previous reports can be found in IBVS No. 5500.

The Editors

Date: 12 February 2004

Observer(s) and affiliation(s):
Sokolovsky, K.V. - Sternberg Astronomical Institute
Antipin, S.V. - Sternberg Astron. Inst. and Inst. of Astron., Russian Acad. Sci., antipin@sai.msu.ru

RA(J2000)	**Dec(J2000)**	**type**	**Mag.**
$17^h01^m21\overset{s}{.}85$	$+42°09'49\overset{''}{.}9$	EW	9.85 – 10.40 pg

Period	**Epoch**
$0\overset{d}{.}3701518$	2444423.337

Cross-identification(s):
BD+42 2782 = SAO 46441 = PPM 55859 = ADS 10314A = TYC 3080-1410-1 = GSC 03080-01410

Date: 16 February 2004

Observer(s) and affiliation(s):
Antipin, S.V. - Sternberg Astron. Inst. and Inst. of Astron., Russian Acad. Sci., antipin@sai.msu.ru

RA(J2000)	**Dec(J2000)**	**type**	**Mag.**
$19^h34^m15\overset{s}{.}76$	$+19°34'13\overset{''}{.}9$	DCEP	14.8 – 15.6 pg

Period	**Epoch**
$5\overset{d}{.}93844$	2441548.42

Cross-identification(s):
Var77 = GSC 01609-01763 = USNO-A2.0 1050-14107101

RA(J2000)	Dec(J2000)	type	Mag.
$19^h37^m09^s.22$	$+19°53'52''.3$	EA	14.5 – <16.6 pg

Period	Epoch
$29^d.361$	2439411.3

Cross-identification(s):
Var78 = USNO-A2.0 1050-14226626

Date: 16 February 2004
Observer(s) and affiliation(s):
Menke, John L. - Menke Scientific, Ltd., john@menkescientific.com

RA(J2000)	Dec(J2000)	type	Mag.
$05^h30^m19^s.05$	$+23°51'26''.8$	EW	11.02 Mpg (GSC)

Period	Epoch
$0^d.3478$	2453001.6425

Cross-identification(s):
GSC 1848-1264 = 1RSX J053021.5+235116

Date: 12 March 2004
Observer(s) and affiliation(s):
Otero, S.A. - Grupo Wezen & CEA, Argentina, varsao@fullzero.com.ar Greaves, J. - Borrowdale Walk, Northampton, UK Wils, P. - Vereniging Voor Sterrenkunde, Belgium, patrick.wils@cronos.be Pojmanski, G., - ASAS, http://www.astrouw.edu.pl/~gp/asas

RA(J2000)	Dec(J2000)	type	Mag.
$12^h26^m18^s$	$-25°46'.3$	EW	12.36 – 13.05 (V)

Period	Epoch
$0^d.371497$	2452386.640

Cross-identification(s):
GSC 6686-0470 = ASAS 122618-2546.3

RA(J2000)	Dec(J2000)	type	Mag.
$13^h28^m02^s$	$-27°29'.8$	EW	12.5: – 13.1: (V)

Period	Epoch
$0^d.302559$	2452488.507

Cross-identification(s):
GSC 6721-1046 = ASAS 132802-2729.8

RA(J2000)	Dec(J2000)	type	Mag.
$13^h08^m07^s$	$-32°54'.2$	EB/KW	12.10 – 12.95: (V)

Period	Epoch
$0^d.410756$	2452699.756

Cross-identification(s):
GSC 7254-1129 = ASAS 130807-3254.2

RA(J2000)	Dec(J2000)	type	Mag.
$13^h07^m41^s$	$-37°29'.5$	EW	11.82 – 12.62 (V)

Period	Epoch
$0^d.370469$	2452712.825

Cross-identification(s):
GSC 7262-0222 = ASAS 130741-3729.5

RA(J2000)	Dec(J2000)	type	Mag.
$13^h29^m06^s$	$-30°07'.8$	EB	11.82 – 12.50 (V)

Period	Epoch
$0^d.539643$	2451924.831

Cross-identification(s):
GSC 7264-2486 = ASAS 132906-3007.8

RA(J2000)	Dec(J2000)	type	Mag.
$13^h28^m11^s$	$-33°23'.8$	EW	12.70 – 13.65 (V)

Period	Epoch
$0^d.389941$	2452452.468

Cross-identification(s):
GSC 7268-0147 = ASAS 132811-3323.8

RA(J2000)	Dec(J2000)	type	Mag.
$13^h33^m57^s$	$-31°53'.3$	EB/KW	12.75 – 13.5 (V)

Period	Epoch
$0^d.323526$	2452760.748

Cross-identification(s):
GSC 7269-0178 = ASAS 133357-3153.3

RA(J2000)	Dec(J2000)	type	Mag.
$14^h28^m33^s$	$-32°08'.4$	EW	10.65 – 11.30 (V)

Period	Epoch
$0^d.399114$	2451924.880

Cross-identification(s):
GSC 7299-1814 = ASAS 142833-3208.4

RA(J2000)	Dec(J2000)	type	Mag.
$21^h02^m39^s$	$-35°43'.6$	EW/KW	12.63 – 13.35: (V)

Period	Epoch
$0^d.286687$	2452893.712

Cross-identification(s):
GSC 7483-0259 = ASAS 210239-3543.6

RA(J2000)	Dec(J2000)	type	Mag.
$21^h47^m30^s$	$-37°15'.9$	EW	11.85 – 12.55 (V)

Period	Epoch
$0^d.421347$	2452177.531

Cross-identification(s):
GSC 7493-0278 = ASAS 214730-3715.9

RA(J2000)	Dec(J2000)	type	Mag.
$21^h40^m04^s$	$-35°33'.1$	EW	12.66 – 13.4 (V)
Period	**Epoch**		
$0^d.371960$	2452068.751		
Cross-identification(s):			
GSC 7493-1749 = ASAS 214004-3533.1			

RA(J2000)	Dec(J2000)	type	Mag.
$23^h28^m01^s$	$-33°59'.8$	EW	12.13 – 12.87 (V)
Period	**Epoch**		
$0^d.385588$	2452940.676		
Cross-identification(s):			
GSC 7517-0234 = ASAS 232801-3359.8			

RA(J2000)	Dec(J2000)	type	Mag.
$12^h44^m53^s$	$-42°44'.2$	EW	11.17 – 11.75 (V)
Period	**Epoch**		
$0^d.370790$	2452738.684		
Cross-identification(s):			
GSC 7779-0761 = ASAS 124453-4244.2			

RA(J2000)	Dec(J2000)	type	Mag.
$13^h35^m02^s$	$-42°19'.7$	EB	11.37 – 11.98 (V)
Period	**Epoch**		
$0^d.613378$	2451996.681		
Cross-identification(s):			
GSC 7796-2177 = ASAS 133502-4219.7			

RA(J2000)	Dec(J2000)	type	Mag.
$13^h56^m43^s$	$-42°24'.3$	EW	10.71 – 11.35 (V)
Period	**Epoch**		
$0^d.506878$	2451979.678		
Cross-identification(s):			
GSC 7798-0500 = ASAS 135643-4224.3			

RA(J2000)	Dec(J2000)	type	Mag.
$15^h09^m23^s$	$-42°55'.2$	EW	12.2 – 12.7 (V)
Period	**Epoch**		
$0^d.67957$	2452134.159		
Cross-identification(s):			
GSC 7829-2155 = ASAS 150923-4255.2			

RA(J2000)	Dec(J2000)	type	Mag.
$15^h16^m43^s$	$-42°28'.2$	EW	11.6 – 11.9: (V)
Period	**Epoch**		
$0^d.347743$	2451985.788		
Cross-identification(s):			
GSC 7830-0168 = ASAS 151643-4228.2			

RA(J2000)	**Dec(J2000)**	**type**	**Mag.**
$14^{h}42^{m}10^{s}$	$-43^{\circ}20\overset{'}{.}1$	EW	10.42 – 10.70 (V)

Period	**Epoch**
$0\overset{d}{.}489307$	2452038.659

Cross-identification(s):
GSC 7831-0069 = ASAS 144210-4320.1

RA(J2000)	**Dec(J2000)**	**type**	**Mag.**
$14^{h}45^{m}42^{s}$	$-44^{\circ}36\overset{'}{.}7$	EW	12.32 – 12.82 (V)

Period	**Epoch**
$0\overset{d}{.}385957$	2452738.722

Cross-identification(s):
GSC 7831-0540 = ASAS 144542-4436.7

RA(J2000)	**Dec(J2000)**	**type**	**Mag.**
$14^{h}49^{m}57^{s}$	$-43^{\circ}28\overset{'}{.}2$	EW	11.35 – 11.78 (V)

Period	**Epoch**
$0\overset{d}{.}365618$	2452813.674

Cross-identification(s):
GSC 7831-0755 = ASAS 144957-4328.2

RA(J2000)	**Dec(J2000)**	**type**	**Mag.**
$14^{h}42^{m}26^{s}$	$-45^{\circ}58\overset{'}{.}1$	EW/KW	12.35 – 13.35 (V)

Period	**Epoch**
$0\overset{d}{.}251562$	2452502.542

Cross-identification(s):
GSC 8279-0997 = ASAS 144226-4558.1

RA(J2000)	**Dec(J2000)**	**type**	**Mag.**
$21^{h}24^{m}47^{s}$	$-47^{\circ}10\overset{'}{.}9$	EW	12.10 – 12.88 (V)

Period	**Epoch**
$0\overset{d}{.}362746$	2452872.914

Cross-identification(s):
GSC 8427-0556 = ASAS 212447-4710.9

RA(J2000)	**Dec(J2000)**	**type**	**Mag.**
$22^{h}23^{m}26^{s}$	$-47^{\circ}10\overset{'}{.}2$	EB	12.35 – 12.9 (V)

Period	**Epoch**
$0\overset{d}{.}78391$	2452566.652

Cross-identification(s):
GSC 8439-1269 = ASAS 222326-4710.2

RA(J2000)	**Dec(J2000)**	**type**	**Mag.**
$14^{h}37^{m}37^{s}$	$-61^{\circ}08\overset{'}{.}8$	EA/KE:	11.97 – 12.96 (V)

Period	**Epoch**
$3\overset{d}{.}17071$	2451939.218

Cross-identification(s):
GSC 9007-5764 = ASAS 143737-6108.8

RA(J2000)	Dec(J2000)	type	Mag.
$15^h59^m06^s$	$-63°17'.8$	EW/KW	10.46 – 11.20 (V)

Period	Epoch
$0^d.266768$	2452151.542

Cross-identification(s):
GSC 9027-4849 = ASAS 155906-6317.8

Date: 17 March 2004

Observer(s) and affiliation(s):
Nakajima, K. - Mie, Japan, K.Nakajima@ztv.ne.jp
Yoshida, S. - MISAO Project, comet@aerith.net
Ohkura, N. - Okayama, Japan, HAE00500@nifty.ne.jp
Kadota, K. - MISAO Project, kenic-k@astroarts.co.jp

RA(J2000)	Dec(J2000)	type	Mag.
$00^h26^m49^s.46$	$+41°49'08''.9$	EA	12.64 – 13.24

Period	Epoch
$1^d.5829$	2452900.1019

Cross-identification(s):
MisV1095 = GSC 2791-02148 = USNO-A2.0 1275.00278138

RA(J2000)	Dec(J2000)	type	Mag.
$00^h56^m44^s.22$	$+41°29'23''.1$	EW	13.48 – 14.25

Period	Epoch
$0^d.4696$	2452930.9602

Cross-identification(s):
MisV1096 = GSC 2806-01699 = USNO-A2.0 1275.00565192

RA(J2000)	Dec(J2000)	type	Mag.
$01^h15^m28^s.73$	$+41°19'59''.3$	EW	13.04 – 13.74

Period	Epoch
$0^d.4688$	2452914.2861

Cross-identification(s):
MisV1097 = GSC 2808-00139 = USNO-A2.0 1275.00747331

RA(J2000)	Dec(J2000)	type	Mag.
$22^h39^m58^s.95$	$+47°20'16''.4$	EA	13.50 – 14.8

Period	Epoch
$4^d.4479$	2452913.1151

Cross-identification(s):
MisV1140 = GSC 3624-01696 = USNO-A2.0 1350.17102713

RA(J2000)	Dec(J2000)	type	Mag.
$23^h18^m59^s.22$	$+48°31'30''.8$	EB	13.80 – 15.14

Period	Epoch
$0^d.9784$	2452958.0826

Cross-identification(s):
MisV1220 = GSC 3640-00577 = USNO-A2.0 1350.18116859

RA(J2000)	Dec(J2000)	type	Mag.
$04^h01^m01^s.17$	$+55°11'09''.8$	EB:	12.68 – 14.04

Period	Epoch
$2^d.6092$	2453003.2500

Cross-identification(s):
MisV1225 = GSC 3722-00767 = USNO-A2.0 1425.04750344

RA(J2000)	Dec(J2000)	type	Mag.
$04^h40^m24^s.45$	$+55°25'14''.2$	EW	12.94 – 13.54

Period	Epoch
$0^d.3662$	2452975.3307

Cross-identification(s):
MisV1226 = GSC 3737-01085 = USNO-A2.0 1425.05422897

RA(J2000)	Dec(J2000)	type	Mag.
$00^h35^m39^s.47$	$+54°55'44''.4$	EA	12.93 – 13.51

Period	Epoch
$2^d.7129$	2453002.1207

Cross-identification(s):
MisV1227 = GSC 3658-00307 = USNO-A2.0 1425.00841436

Date: 24 March 2004

Observer(s) and affiliation(s):
Wils, Patrick - Vereniging Voor Sterrenkunde, Belgium
Greaves, J. - Borrowdale Walk, Northampton, UK
SkyDOT team - http://skydot.lanl.gov

RA(J2000)	Dec(J2000)	type	Mag.
$02^h14^m26^s.6$	$+59°45'12''$	GCAS	11.3 – 10.8 ROTSE1

Period	Epoch
–	–

Cross-identification(s):
GSC 03698-00449 = VES 721 (Halpha) = LS I +59 115 = ALS 6999

Date: 29 March 2004

Observer(s) and affiliation(s):
Nakajima, K. - Mie, Japan, K.Nakajima@ztv.ne.jp
Yoshida, S. - MISAO Project, comet@aerith.net
Ohkura, N. - Okayama, Japan, HAE00500@nifty.ne.jp
Kadota, K. - Ageo City, Saitama, Japan, kenic-k@astroarts.co.jp

RA(J2000)	Dec(J2000)	type	Mag.
$21^h00^m17^s.97$	$+27°52'56''.1$	EA	12.14 – 12.81 (V)

Period	Epoch
$3^d.0421$	2452871.0792

Cross-identification(s):
MisV1061 = GSC 2180-00207 = USNO-A2.0 1125.17620700

RA(J2000)	Dec(J2000)	type	Mag.
$20^h14^m38\overset{s}{.}61$	$+41°56'14\overset{''}{.}3$	EB:	13.79 – 15.03

Period	Epoch
$0\overset{d}{.}6331$	2452873.9913

Cross-identification(s):
MisV1105 = GSC 3159-01247 = USNO-A2.0 1275.13699980

Date: 29 March 2004

Observer(s) and affiliation(s):
Greaves, J. - Northampton, UK
SkyDOT team - http://skydot.lanl.gov
Pojmanski, G., - ASAS, http://www.astrouw.edu.pl/ gp/asas

A list of over four hundred objects in the Northern Halpha emission catalogue of Kohoutek & Wehmeyer (1999) that are flagged as being OB stars was checked against the online archives of the the Northern Star Variability Survey (NSVS) and/or All Sky Automated Survey (ASAS, which currently covers the sky only south of around +30) for objects showing evident secular variation or outbursting activity.

RA(J2000)	Dec(J2000)	type	Mag.
$01^h16^m16\overset{s}{.}7$	$+63°31'52''$	BE	11.7 – 11.9 ROTSE1

Period	Epoch
–	–

Cross-identification(s):
GSC 04034 00200 = [KW97] 5-15 = ALS 6509 = LS I +63 140

RA(J2000)	Dec(J2000)	type	Mag.
$18^h53^m54\overset{s}{.}9$	$-00°48'12''$	BE	11.9 – 12.1 (V)

Period	Epoch
–	–

Cross-identification(s):
GSC 05115 01862 = [KW97] 35-19 = SS 426 (Halpha)

RA(J2000)	Dec(J2000)	type	Mag.
$19^h28^m52\overset{s}{.}3$	$+27°10'02''$	BE	12.4 – 12.7 (V)

Period	Epoch
–	–

Cross-identification(s):
GSC 02133 01034 = EM* AS 357 = HBHA 2702-03 = ALS 10307 = LS II +27 4 = MSX6C G061.2134+04.5572

RA(J2000)	Dec(J2000)	type	Mag.
$06^h33^m26\overset{s}{.}6$	$-00°04'30''$	GCAS	10.8 – 10.5 (V)

Period	Epoch
–	–

Cross-identification(s):
HD 291802 = [KW97] 29-49 = SS 47 (Halpha) = ASAS3 063326-0004.5

RA(J2000)	Dec(J2000)	type	Mag.
$18^h57^m50^s.4$	$+01°31'15''$	GCAS	11.3 – 11.0 (V)

Period	Epoch
–	–

Cross-identification(s):
GSC 00449 00275 = HBHA 203-09 = [KW97] 35-31 = SS 427 (Halpha) = MSX6C G035.0160-00.7307

RA(J2000)	Dec(J2000)	type	Mag.
$19^h22^m30^s.8$	$+11°57'34''$	GCAS	10.8 – 10.5 ROTSE1

Period	Epoch
–	–

Cross-identification(s):
GSC 01050 00569 = EM* AS 355 = [KW97] 37-11 = ALS 10268 = LS IV +11 9

RA(J2000)	Dec(J2000)	type	Mag.
$20^h20^m27^s.3$	$+37°09'58''$	GCAS:	11.6 – 11.2 ROTSE1

Period	Epoch
–	–

Cross-identification(s):
GSC 02684 00589 = EM* CDS 1155 = [KW97] 45-30 = ALS 11186 = LS II +37 68

RA(J2000)	Dec(J2000)	type	Mag.
$20^h21^m56^s.8$	$+36°39'50''$	GCAS	11.7 – 11.3 ROTSE1

Period	Epoch
–	–

Cross-identification(s):
GSC 02684 00514 = EM* CDS 4661 = [KW97] 45-51 = ALS 11224 = LS II +36 68 = ISOGAL-P-J202157.1+363945

RA(J2000)	Dec(J2000)	type	Mag.
$20^h25^m31^s.9$	$+44°54'15''$	GCAS	11.8 – 11.4 ROTSE1

Period	Epoch
–	–

Cross-identification(s):
GSC 03164 00140 = EM* CDS 1169 = [KW97] 46-40 = ALS 11336 = LS III +44 15

RA(J2000)	Dec(J2000)	type	Mag.
$22^h57^m14^s.8$	$+57°28'45''$	GCAS	11.1 – 10.7 ROTSE1

Period	Epoch
–	–

Cross-identification(s):
GSC 03993 01433 = EM* CDS 1423 = [KW97] 66-37 = ALS 12706 = LS III +57 107

RA(J2000)	Dec(J2000)	type	Mag.
$23^h01^m09\overset{s}{.}6$	$+59°56'41''$	GCAS	11.7 – 11.2 ROTSE1

Period	Epoch
–	–

Cross-identification(s):
GSC 03997 1517 = EM* CDS 5187 = [KW97] 66-56 = ALS 12737 = LS III +59 36

Date: 2 April 2004

Observer(s) and affiliation(s):
Nakajima, K. - Mie, Japan, K.Nakajima@ztv.ne.jp
Yoshida, S. - MISAO Project, comet@aerith.net
Ohkura, N. - Okayama, Japan, HAE00500@nifty.ne.jp

RA(J2000)	Dec(J2000)	type	Mag.
$23^h50^m17\overset{s}{.}12$	$+51°11'29\overset{''}{.}1$	EB:	13.61 – 14.71

Period	Epoch
$0\overset{d}{.}4288$	2452937.0855

Cross-identification(s):
MisV1222 = GSC 3651-00655 = USNO-A2.0 1350.18742581

RA(J2000)	Dec(J2000)	type	Mag.
$00^h12^m02\overset{s}{.}69$	$+55°05'19\overset{''}{.}6$	EW	11.97 – 12.61

Period	Epoch
$1\overset{d}{.}0650$	2452960.2298

Cross-identification(s):
MisV1239 = GSC 3656-01495 = USNO-A2.0 1425.00290138

Date: 7 April 2004

Observer(s) and affiliation(s):
Galeev, A. I. - Kazan State University, Department of Astronomy, almaz@ksu.ru

RA(J2000)	Dec(J2000)	type	Mag.
$06^h58^m08\overset{s}{.}12$	$-07°17'46\overset{''}{.}0$	DSCT	11.13 – 11.15 (V)

Period	Epoch
$0\overset{d}{.}0337062$	2452994.487

Cross-identification(s):
GSC 4813-0981 = TYC 4813- 981-1

Date: 15 April 2004
Observer(s) and affiliation(s): Quester, W. - BAV, Germany, wquester@aol.com Frank, P. - BAV, Germany, frank.velden@t-online.de Bernhard, K. - BAV, Austria, kl.bernhard@aon.at

RA(J2000)	**Dec(J2000)**	**type**	**Mag.**
$19^{h}45^{m}53\overset{s}{.}27$	$+32°13'34\overset{''}{.}1$	SR	13.4 – 14.4 (R)

Period	**Epoch**
–	–

Cross-identification(s):
Qu2 = USNO-A2.0 1200-13096580 = 2MASS J194553.27+321335.02

RA(J2000)	**Dec(J2000)**	**type**	**Mag.**
$19^{h}45^{m}43\overset{s}{.}43$	$+32°10'01\overset{''}{.}6$	EW	13.7 – 14.0 (V)

Period	**Epoch**
$0\overset{d}{.}648886$	2452517.448

Cross-identification(s):
Fr5 = USNO-A2.0 1200-13084491

RA(J2000)	**Dec(J2000)**	**type**	**Mag.**
$05^{h}26^{m}20\overset{s}{.}2$	$+15°37'00\overset{''}{.}1$	EW	12.4 – 12.8 (V)

Period	**Epoch**
$0\overset{d}{.}71738$	2453059.568

Cross-identification(s):
Brh V144 = GSC 1296.0975 = USNO-B1.0 1056-0077597

Date: 30 April 2004
Observer(s) and affiliation(s): Husar, Dieter - BAV, Himmelsmoor-Private-Observatory, Himmelsmoor 18, D-22397 Hamburg, Germany, husar.d@gmx.de

RA(J2000)	**Dec(J2000)**	**type**	**Mag.**
$23^{h}42^{m}33\overset{s}{.}8$	$+56°11'20''$	dSct:	10.55 – 10.63 (V-inst.)

Period	**Epoch**
$0\overset{d}{.}139$	–

Cross-identification(s):
GSC 04004-00249 = TYC 4004-249-1

Date: 5 May 2004

Observer(s) and affiliation(s):
Krisciunas, K. - University of Notre Dame, kkrisciu@cygnus.phys.nd.edu
Candia, P. - Cerro Tololo Inter-American Observatory, pcandia@ctio.noao.edu
Suntzeff, N. B. - Cerro Tololo Inter-American Observatory, nsuntzeff@noao.edu

RA(J2000)	**Dec(J2000)**	**type**	**Mag.**
$12^h47^m37\overset{s}{.}0$	$-39°32'43''$	RRab	16.72 – 16.20 (V)

Period	**Epoch**
$0\overset{d}{.}6405 \pm 0\overset{d}{.}0002$	2452101.34

Cross-identification(s):
GSC2.2 S23202122078

Date: 25 May 2004

Observer(s) and affiliation(s):
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Quester, Wolfgang - Germany WQUESTER@aol.com
Frank, Peter - Velden,Germany, BAV, frank.velden@t-online.de

RA(J2000)	**Dec(J2000)**	**type**	**Mag.**
$21^h28^m13\overset{s}{.}68$	$+11°57'44\overset{''}{.}9$	EB	11.95 (V, max)

Period	**Epoch**
$1\overset{d}{.}4797 \pm 0\overset{d}{.}0005$	2452900.61

Cross-identification(s):
Lsm1 = GSC 1127-1808

Date: 30 June 2004

Observer(s) and affiliation(s):
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R. Behrend - Geneva Observatory, CH-1290 Sauverny, Switzerland, raoul.behrend@obs.unige.ch
C. Rinner - Ottmarsheim Observatory, 5 rue du Lièvre, F-68490 Ottmarsheim, France, rinnerc@wanadoo.fr

RA(J2000)	**Dec(J2000)**	**type**	**Mag.**
$00^h00^m18\overset{s}{.}20$	$+19°32'55\overset{''}{.}5$	RR	15.3

Period	**Epoch**
$0\overset{d}{.}54540$	2452550.361

Cross-identification(s):
GSC 1181-1005

RA(J2000)	**Dec(J2000)**	**type**	**Mag.**
$03^h51^m26\overset{s}{.}19$	$+17°15'35\overset{''}{.}4$	EW	14.8

Period	**Epoch**
$0\overset{d}{.}350461$	2452612.590

Cross-identification(s):
GSC 1252-558

RA(J2000)	Dec(J2000)	type	Mag.
$10^{h}56^{m}03\overset{s}{.}07$	$+20°40'40\overset{''}{.}1$	EW	14.9
Period		**Epoch**	
$0\overset{d}{.}31738$		2452721.526	
Cross-identification(s):			
GSC 1435-477			

RA(J2000)	Dec(J2000)	type	Mag.
$09^{h}04^{m}04\overset{s}{.}82$	$+17°51'25\overset{''}{.}7$	EW	16.0
Period		**Epoch**	
$0\overset{d}{.}2876726$		2452721.274	
Cross-identification(s):			
USNO-A2.0 1050-5946346			

RA(J2000)	Dec(J2000)	type	Mag.
$09^{h}00^{m}51\overset{s}{.}40$	$+34°22'36\overset{''}{.}0$	EW	13.0
Period		**Epoch**	
$0\overset{d}{.}2937757$		2452721.298	
Cross-identification(s):			
GSC 2495-1146			

RA(J2000)	Dec(J2000)	type	Mag.
$14^{h}42^{m}12\overset{s}{.}52$	$+03°24'14\overset{''}{.}2$	EW	12.2
Period		**Epoch**	
$0\overset{d}{.}350954$		2452766.289	
Cross-identification(s):			
GSC 329-639			

RA(J2000)	Dec(J2000)	type	Mag.
$14^{h}41^{m}25\overset{s}{.}72$	$+03°39'00\overset{''}{.}2$	EW	14.0
Period		**Epoch**	
$0\overset{d}{.}2598830$		2452788.307	
Cross-identification(s):			
GSC 329-256			

RA(J2000)	Dec(J2000)	type	Mag.
$14^{h}24^{m}04\overset{s}{.}72$	$-11°24'53\overset{''}{.}8$	RR	14.2
Period		**Epoch**	
$0\overset{d}{.}552574$		2452788.419	
Cross-identification(s):			
GSC 5570-331			

RA(J2000)	Dec(J2000)	type	Mag.
$20^{h}42^{m}43\overset{s}{.}80$	$-09°05'45\overset{''}{.}1$	DSCT ?	13.6
Period		**Epoch**	
$0\overset{d}{.}083195$		2452854.527	
Cross-identification(s):			
GSC 5756-277			

RA(J2000)	Dec(J2000)	type	Mag.
$20^h43^m15^s.74$	$-09°09'28''.2$	RR	13.1

Period	Epoch
$0^d.51217$	2452854.328

Cross-identification(s):
GSC 5756-373

RA(J2000)	Dec(J2000)	type	Mag.
$20^h04^m55^s.85$	$+01°21'56''.9$	EB	11.8

Period	Epoch
$0^d.67856$	2452874.574

Cross-identification(s):
GSC 494-587

RA(J2000)	Dec(J2000)	type	Mag.
$05^h30^m19^s.09$	$+23°51'26''.7$	EW	11.1

Period	Epoch
$0^d.34767$	2453000.246

Cross-identification(s):
GSC 1848-1264

Date: 30 June 2004

Observer(s) and affiliation(s):
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C. Rinner - Ottmarsheim Observatory, 5 rue du Lièvre, F-68490 Ottmarsheim, France, rinnerc@wanadoo.fr

RA(J2000)	Dec(J2000)	type	Mag.
$12^h35^m32^s.04$	$+14°19'33''.5$	EW/EB	12.3

Period	Epoch
$0^d.58283$	2452763.558

Cross-identification(s):
GSC 880-55

RA(J2000)	Dec(J2000)	type	Mag.
$21^h30^m01^s.50$	$+15°26'45''.0$	EW	13.8

Period	Epoch
$0^d.40673$	2452855.701

Cross-identification(s):
GSC 1664-249

RA(J2000)	Dec(J2000)	type	Mag.
$21^{h}29^{m}47\overset{s}{.}95$	$+15°28'32\overset{''}{.}3$	EW	13.5

Period	Epoch
$0\overset{d}{.}312995$	2452854.540

Cross-identification(s):
GSC 1664-1837

Date: 30 June 2004

Observer(s) and affiliation(s):
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C. Rinner - Ottmarsheim Observatory, 5 rue du Lièvre, F-68490 Ottmarsheim, France, rinnerc@wanadoo.fr

RA(J2000)	Dec(J2000)	type	Mag.
$20^{h}55^{m}01\overset{s}{.}27$	$-06°57'55\overset{''}{.}1$	EW	13.3

Period	Epoch
$0\overset{d}{.}240932$	2452877.467

Cross-identification(s):
GSC 5191-625

RA(J2000)	Dec(J2000)	type	Mag.
$20^{h}53^{m}56\overset{s}{.}03$	$-06°32'01\overset{''}{.}3$	EW	13.8

Period	Epoch
$0\overset{d}{.}40210$	2452877.558

Cross-identification(s):
GSC 5191-853

Date: 30 June 2004

Observer(s) and affiliation(s):
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RA(J2000)	Dec(J2000)	type	Mag.
$20^{h}54^{m}13\overset{s}{.}34$	$-08°18'37\overset{''}{.}2$	EW	16.2

Period	Epoch
$0\overset{d}{.}25325$	2452887.681

Cross-identification(s):
USNO-A2.0 750-20488243

RA(J2000)	Dec(J2000)	type	Mag.
$20^h54^m38\overset{s}{.}05$	$-07°38'55\overset{''}{.}6$	EW	16.0

Period	Epoch
$0\overset{d}{.}2694$	2452887.526

Cross-identification(s):
USNO-A2.0 750-20493453

Date: 30 June 2004

Observer(s) and affiliation(s):
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RA(J2000)	Dec(J2000)	type	Mag.
$14^h19^m52\overset{s}{.}42$	$-06°23'02\overset{''}{.}8$	RR	14.2

Period	Epoch
$0\overset{d}{.}492750$	2452411.575

Cross-identification(s):
GSC 4982-1039

Date: 30 June 2004

Observer(s) and affiliation(s):
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RA(J2000)	Dec(J2000)	type	Mag.
$13^h50^m48\overset{s}{.}79$	$+01°33'18\overset{''}{.}5$	EW	15.4

Period	Epoch
$0\overset{d}{.}2564941$	2452419.578

Cross-identification(s):
USNO-A2.0 900-7503929

Date: 30 June 2004

Observer(s) and affiliation(s):
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R. Behrend - Geneva Observatory, CH-1290 Sauverny, Switzerland, raoul.behrend@obs.unige.ch
C. Rinner - Ottmarsheim Observatory, 5 rue du Lièvre, F-68490 Ottmarsheim, France, rinnerc@wanadoo.fr

RA(J2000)	**Dec(J2000)**	**type**	**Mag.**
$21^{h}00^{m}47\overset{s}{.}51$	$+14°52'46\overset{''}{.}3$	EW	12.4

Period	**Epoch**
$0\overset{d}{.}631308$	2452497.69

Cross-identification(s):
GSC 1115-672

Date: 30 June 2004

Observer(s) and affiliation(s):
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C. Rinner - Ottmarsheim Observatory, 5 rue du Lièvre, F-68490 Ottmarsheim, France, rinnerc@wanadoo.fr

RA(J2000)	**Dec(J2000)**	**type**	**Mag.**
$17^{h}15^{m}36\overset{s}{.}77$	$-10°06'42\overset{''}{.}0$	EW	12.9

Period	**Epoch**
$0\overset{d}{.}54564$	2452827.284

Cross-identification(s):
GSC 5649-113

Date: 30 June 2004

Observer(s) and affiliation(s):
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C. Rinner - Ottmarsheim Observatory, 5 rue du Lièvre, F-68490 Ottmarsheim, France, rinnerc@wanadoo.fr

RA(J2000)	**Dec(J2000)**	**type**	**Mag.**
$05^h02^m02\overset{s}{.}29$	$+42°37'55\overset{''}{.}6$	EW	12.9

Period	**Epoch**
$0\overset{d}{.}39788$	2452999.230

Cross-identification(s):
GSC 2903-237

Date: 30 June 2004

Observer(s) and affiliation(s):
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RA(J2000)	**Dec(J2000)**	**type**	**Mag.**
$07^h12^m07\overset{s}{.}26$	$+25°57'50\overset{''}{.}1$	EB	15.2

Period	**Epoch**
$0\overset{d}{.}42310$	2452999.336

Cross-identification(s):
USNO-A2.0 1125-04937012

Date: 30 June 2004

Observer(s) and affiliation(s):
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A. Klotz - TAROT, Haute-Provence Observatory, F-04870 St-Michel l'Observatoire, France, alain.klotz@cesr.fr
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C. Rinner - Ottmarsheim Observatory, 5 rue du Lièvre, F-68490 Ottmarsheim, France, rinnerc@wanadoo.fr

RA(J2000)	**Dec(J2000)**	**type**	**Mag.**
$06^h59^m47^s.30$	$+22°29'48''.6$	EW	12.5

Period	**Epoch**
$0^d.25614$	2453051.3060

Cross-identification(s):
GSC 1356-2826

Date: 21 September 2004

Observer(s) and affiliation(s):
Otero, S.A. - Grupo Wezen 1 88 & CEA, Argentina, varsao@fullzero.com.ar
Pojmanski, G. - ASAS, http://www.astrouw.edu.pl/~gp/asas

RA(J2000)	**Dec(J2000)**	**type**	**Mag.**
$13^h32^m25^s.26$	$-74°36'35''.8$	RRC	8.17 – 8.35 (V)

Period	**Epoch**
$0^d.369054$	2452704.788

Cross-identification(s):
HD 117316 = CPD −73 1158 = GSC 9254-1886 = ASAS 133226-7436.6

Date: 18 October 2004
Observer(s) and affiliation(s): Michael Sallman - Roseville, MN USA, TASS, AAVSO, msallman@pro-ns.net Thomas Droege - Batavia, IL USA, TASS http://www.tass-survey.org

RA(J2000)	**Dec(J2000)**	**type**	**Mag.**
$19^{h}15^{m}12\overset{s}{.}13$	$+39^{\circ}42'50\overset{''}{.}5$	SRd	10.3 – 11.2 (V)

Period	**Epoch**
$125\overset{d}{.}4$	2453221.1 (max)

Cross-identification(s): GSC 3125-2395 = IRAS 19135+3937

Date: 11 November 2004
Observer(s) and affiliation(s): Roger Persson - Takkullevagen 1254, 430 63 Hindas, Sweden, regulus1@telia.com

Object found on POSS-II (epoch: 1991.672) is not visible on POSS-I (epoch: 1953.830).

RA(J2000)	**Dec(J2000)**	**type**	**Mag.**
$22^{h}53^{m}33\overset{s}{.}4$	$+62^{\circ}32'23''$	FUor? EXor?	15.72(R)

Period	**Epoch**
–	–

Cross-identification(s): Persson's star = USNO-B1.0 1525-0418304

Date: 17 November 2004
Observer(s) and affiliation(s): Antipin, S.V. - Sternberg Astron. Inst. and Inst. of Astron., Russian Acad. Sci., antipin@sai.msu.ru

RA(J2000)	**Dec(J2000)**	**type**	**Mag.**
$21^{h}54^{m}30\overset{s}{.}15$	$+35^{\circ}51'46\overset{''}{.}2$	EW	14.6 (r, USNO-A2.0)

Period	**Epoch**
$0\overset{d}{.}442868$	2452543.250

Cross-identification(s): Antipin V81 = USNO-A2.0 1200-18678842 = USNO-B1.0 1258-0505550

Date: 1 February 2005

Observer(s) and affiliation(s):
Christie, G.W. - Auckland Observatory, P.O.Box 24-180, Auckland, New Zealand, grant@christie.org.nz McCormick, J. - Farm Cove Observatory Natusch, T. - Auckland Observatory

RA(J2000)	**Dec(J2000)**	**type**	**Mag.**
$06^{\mathrm{h}}34^{\mathrm{m}}47\overset{\mathrm{s}}{.}176$	$-62^{\circ}35'38\overset{''}{.}29$	EW	15.5 (unfiltered CCD)

Period	**Epoch**
$0\overset{\mathrm{d}}{.}3119$	2453392.0053

Cross-identification(s):
GSC 8899-230 = USNO-A2 0225 03113874

Date: 2 February 2005

Observer(s) and affiliation(s):
Brat, L. - Velka Upa 193, 542 21 Pec pod Snezkou, Czech Republic, brat@pod.snezkou.cz Motl D. - Brno Observatory, Czech Republic, dmotl@volny.cz

RA(J2000)	**Dec(J2000)**	**type**	**Mag.**
$10^{\mathrm{h}}03^{\mathrm{m}}46\overset{\mathrm{s}}{.}34$	$+01^{\circ}25'9\overset{''}{.}6$	EB	11.6-11.9 (V)

Period	**Epoch**
$0\overset{\mathrm{d}}{.}603577$	2453386.6120

Cross-identification(s):
GSC 0244-0434 = BAL 1435 = AG+01 1260 = BD+02 2285 = PPM 156466

Reference:

Kohoutek L, Wehmeyer R, 1999, *Astron & Astroph. Suppl. Ser.*, **134**, 255